

# ESnet Report

The background of the slide is a dark blue gradient. On the right side, there is a bright white light source that emits several broad, translucent blue rays that fan out towards the left. In the center-left area, there is a vertical column of faint, glowing binary code (0s and 1s) that appears to be part of the light effect. A thin, solid white horizontal line cuts across the middle of the slide, passing behind the text.

**ESSC**

James F. Leighton

March 18, 2003

Bethesda, MD

# TOPICS

- PART I: Meeting Requirements
- PART II: Status Report
- PART III: Foundation for a Business Case

# TOPICS

- PART I: Meeting Requirements
  - – Planning for the near term
  - Other Services
  - New Directions?
- PART II: Status Report
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# Part I

- A look at plans and progress to meet basic bandwidth and services demands

# Predicting the Future

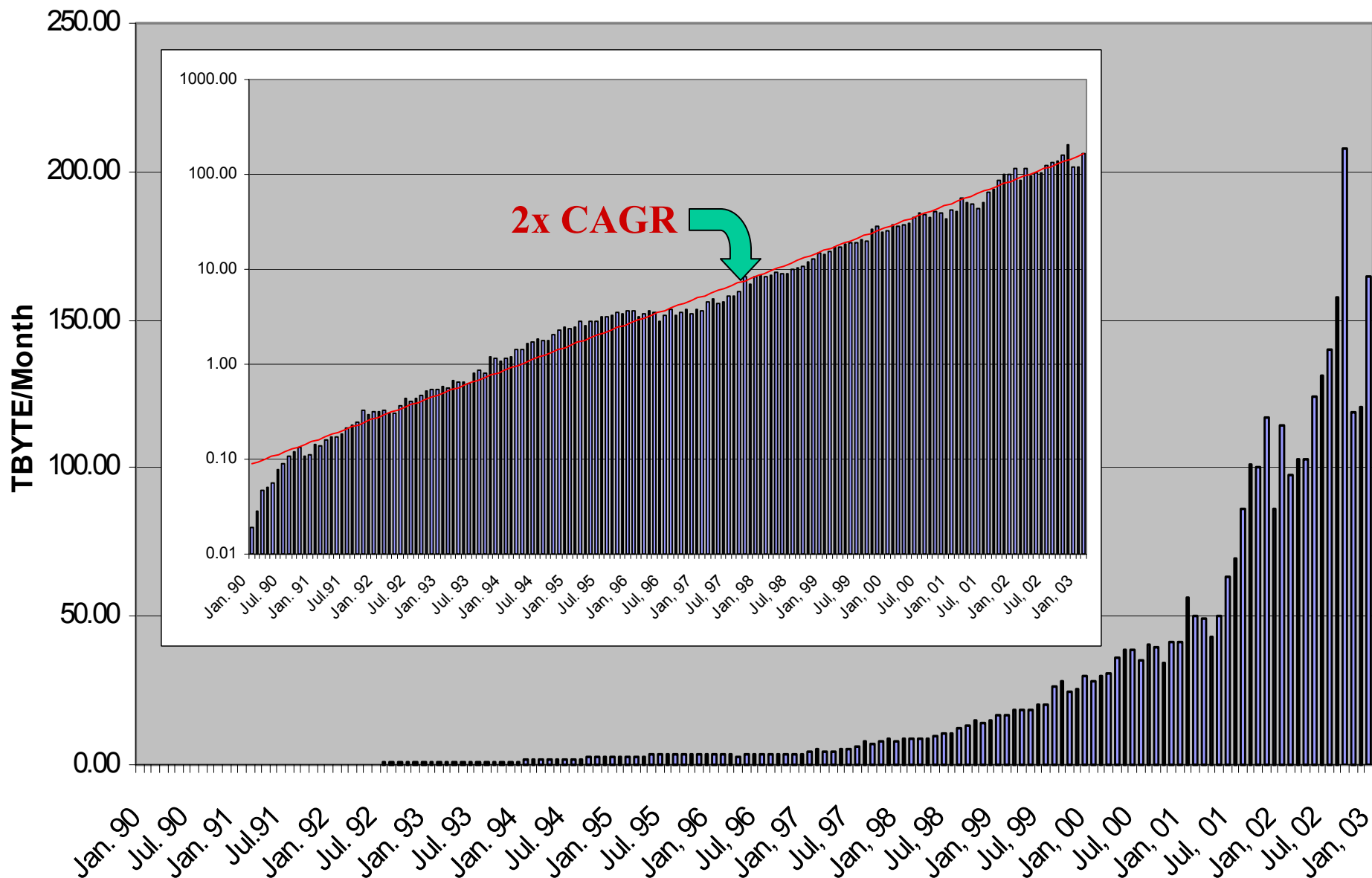
Predicting the future is harder than predicting almost anything else, and often notoriously inaccurate ...

...Probably because everything we think we know about the future is based on the past ...

...Nevertheless...

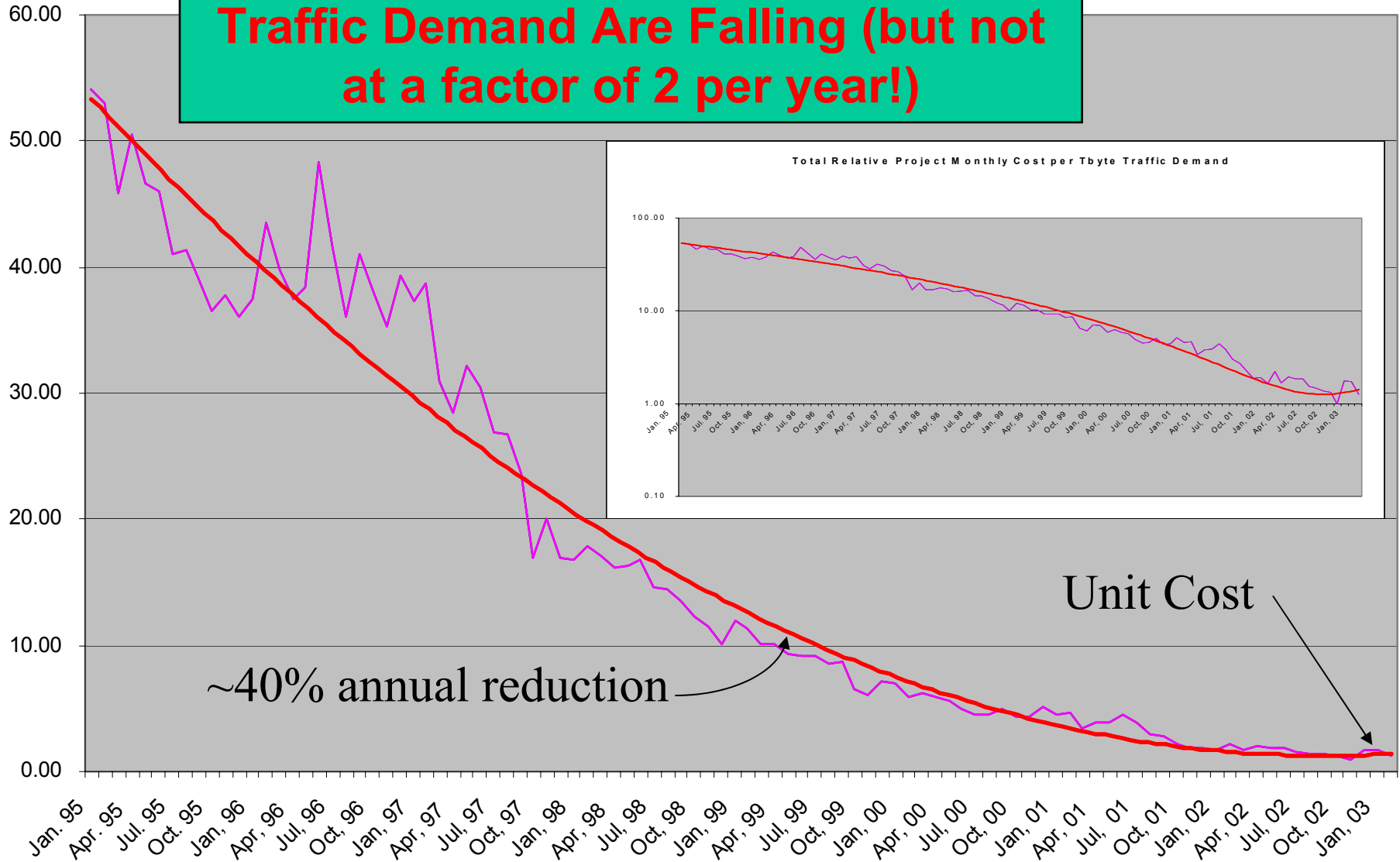


# ESnet Monthly Accepted Traffic



## Total Relative Project Monthly Cost per Tbyte Traffic Demand

**Total Project Costs Per Unit of Traffic Demand Are Falling (but not at a factor of 2 per year!)**



# Programmatic Projections

Programmatic Projections can be “enthusiastic”

Table 11: Summary of installed bandwidth requirements (in Mbps) by experiment

	2001	2002	2003	2004	2005	2006
<b>CMS</b>	100	200	300	600	800	2500
<b>ATLAS</b>	50	100	300	600	800	2500
<b>BABAR</b>	300	600	1100	1600	2300	3000
<b>CDF</b>	100	300	400	2000	3000	6000
<b>Dzero</b>	400	1600	2400	3200	6400	8000
<b>BTeV</b>	20	40	100	200	300	500
<b>DESY</b>	100	180	210	240	270	300
<b>Total Bandwidth</b>	1070	3020	4810	8440	13870	22800
<b>US-CERN BW</b>	155-310	622	1250	2500	5000	10000

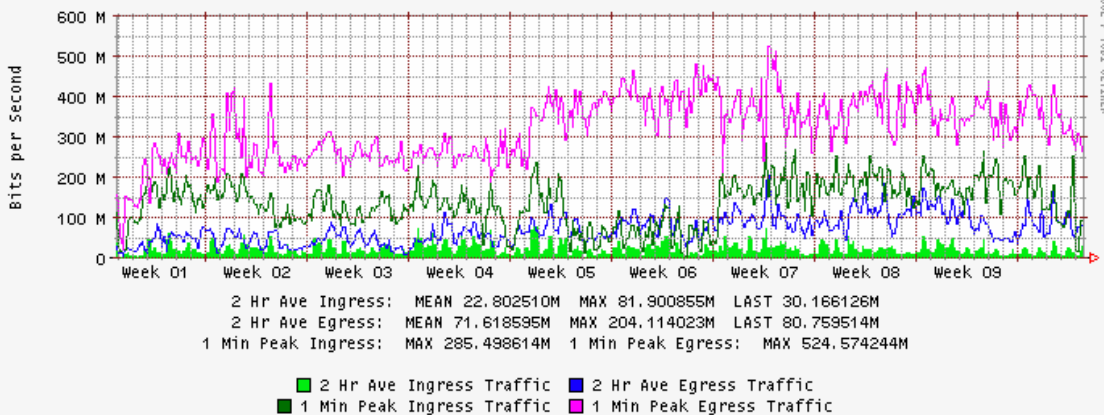
Table 12: Summary of Installed Bandwidth Requirements by Laboratory

	2001	2002	2003	2004	2005	2006
<b>SLAC</b>	OC12	2 X OC12	2 X OC12	OC48	OC48	2 X OC48
<b>BNL</b>	OC12	2 X OC12	2 X OC12	OC48	OC48	2 X OC48
<b>FNAL</b>	OC12	OC48	2 X OC48	OC192	OC192	2 X OC192
<b>US-CERN</b>	2 X OC3	OC12	2 X OC12	OC48	2 X OC48	OC192
<b>US-DESY</b>	OC3	2 X OC3	2 X OC3	2 X OC3	2 X OC3	OC12

But even these are nearly all below a 100% compound annual growth rate!



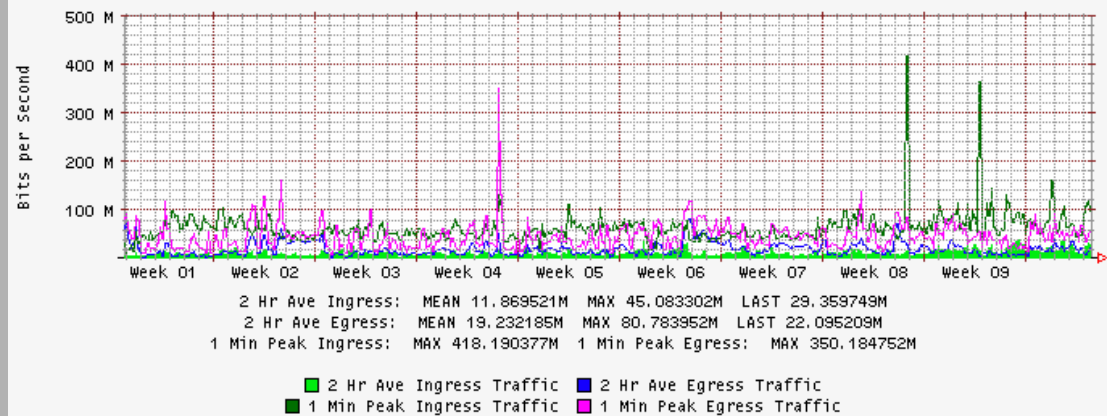
fnal-rt1: so-0/1/0 (27) (2 Hr Average) [Fri Mar 7 11:08:14 PST 2003]



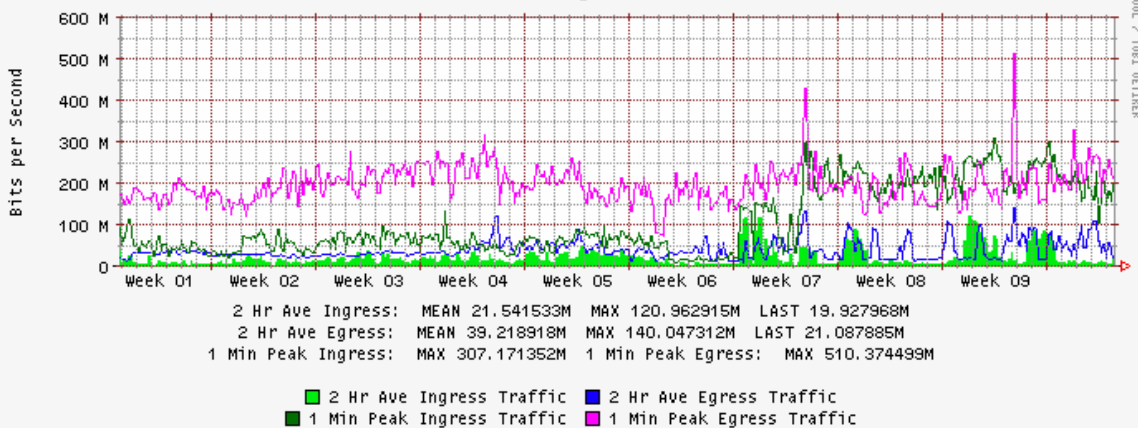
FNAL

BNL

bnl-rt2: so-0/1/0 (39) (2 Hr Average) [Fri Mar 7 11:17:49 PST 2003]



slac-rt4: so-1/1/0 (48) (2 Hr Average) [Fri Mar 7 11:21:01 PST 2003]



SLAC

# Commercial Traffic

Many projections for “commodity” traffic are below the 100% per year growth rate

## Divergent Forecasts:

McKinsey: Growth slows to 60% by 2005

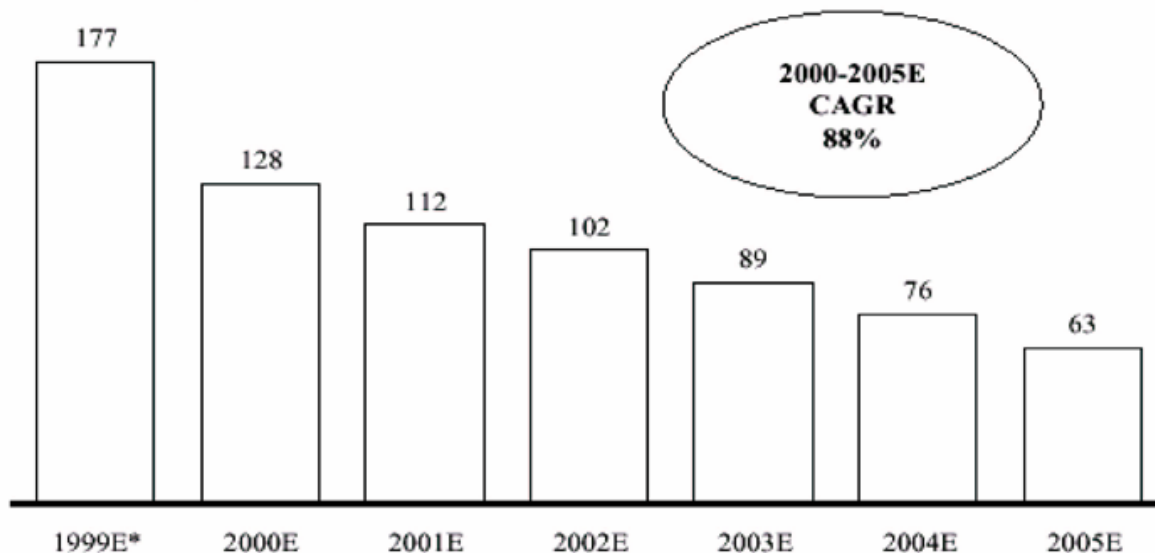
AT&T: Growth has slowed, but will resume

Roberts: Growth should be near 3X rate

Cohen: Growth is slowing, but goes to 150% after 2005 due to growth of grid computing and web services.

**Chart 1: IP Traffic Growth**

(percent; year/year growth)

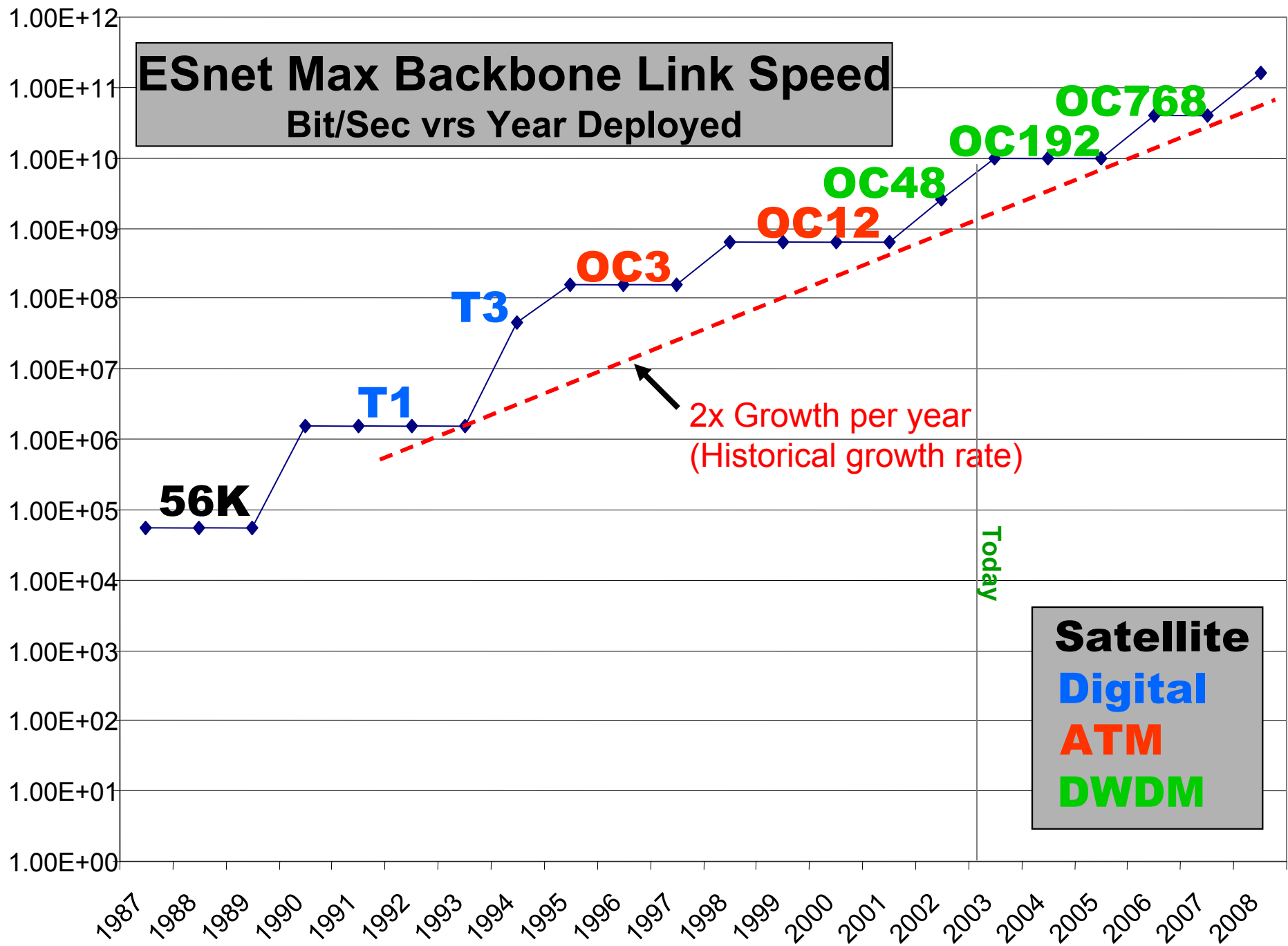


Source: AT&T Labs; McKinsey & Company and JPMorgan analysis and estimates.

\*Based on AT&T Labs traffic estimates.

Cohen: NGN 2002

# ESnet Max Backbone Link Speed Bit/Sec vrs Year Deployed

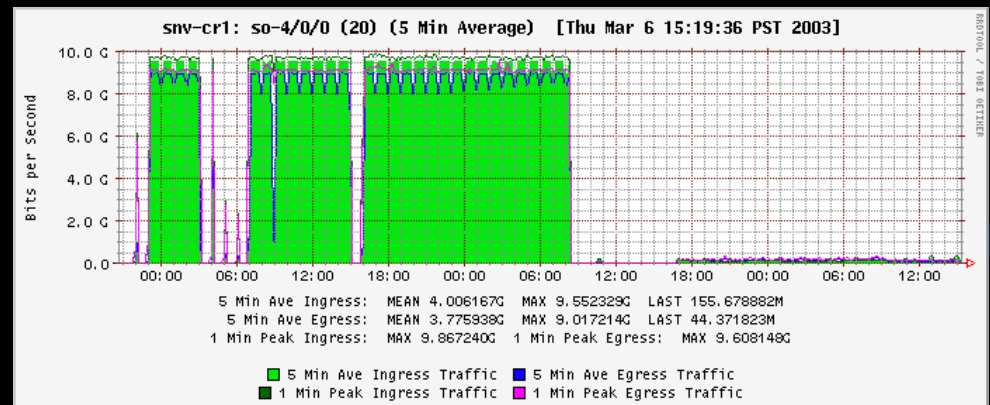


# OC 48/192 Deployment

- We have now completed the ESnet backbone upgrade from OC12 SONET + ATM to OC48 and OC192 DWDM (wavelength) service (a factor of 4 and 16)
- Four OC48 DWDM links are now operational on the full “southern route” as of Jan 9, 2003
  - To be upgraded to OC192 in Q1 FY05
- Two OC192 links on the northern route were moved into production on 5 Mar 2003.

# OC 48/192 Deployment

- It is never as simple as it “should” be
  - Cost of the hardware and availability
  - New hub location prep (NY, DC, ATL, ELP)
  - “Roll-over” of several sites to the new hubs
  - Testing at OC48 and OC192
  - On-going ATM support for SecureNet clients
- But it has gone fairly smoothly
  - It is worth noting that an DWDM OC192 of over a thousand miles length can run at capacity error-free for 24 hours!



# ESnet BACKBONE Early 2003

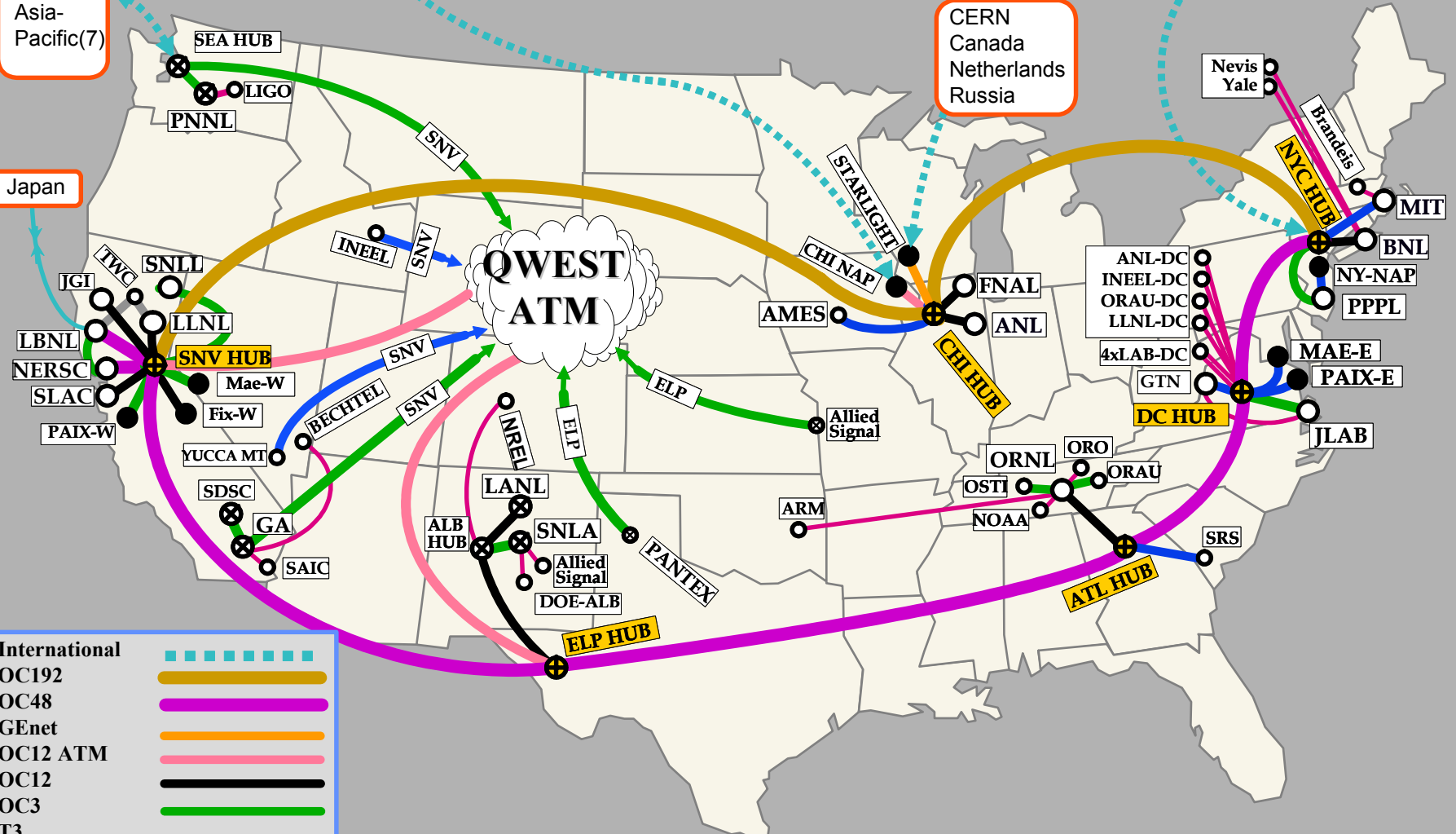
Canada France  
China Iceland  
Denmark Norway  
Finland Taiwan  
Japan Sweden  
Singapore

Australia  
Canada  
Taiwan  
Asia-Pacific(7)

Europe (27)  
- Germany  
- France  
- Italy  
- UK  
Israel  
Japan-Russia

CERN  
Canada  
Netherlands  
Russia

Japan



International

OC192

OC48

GEnet

OC12 ATM

OC12

OC3

T3

T1-T3

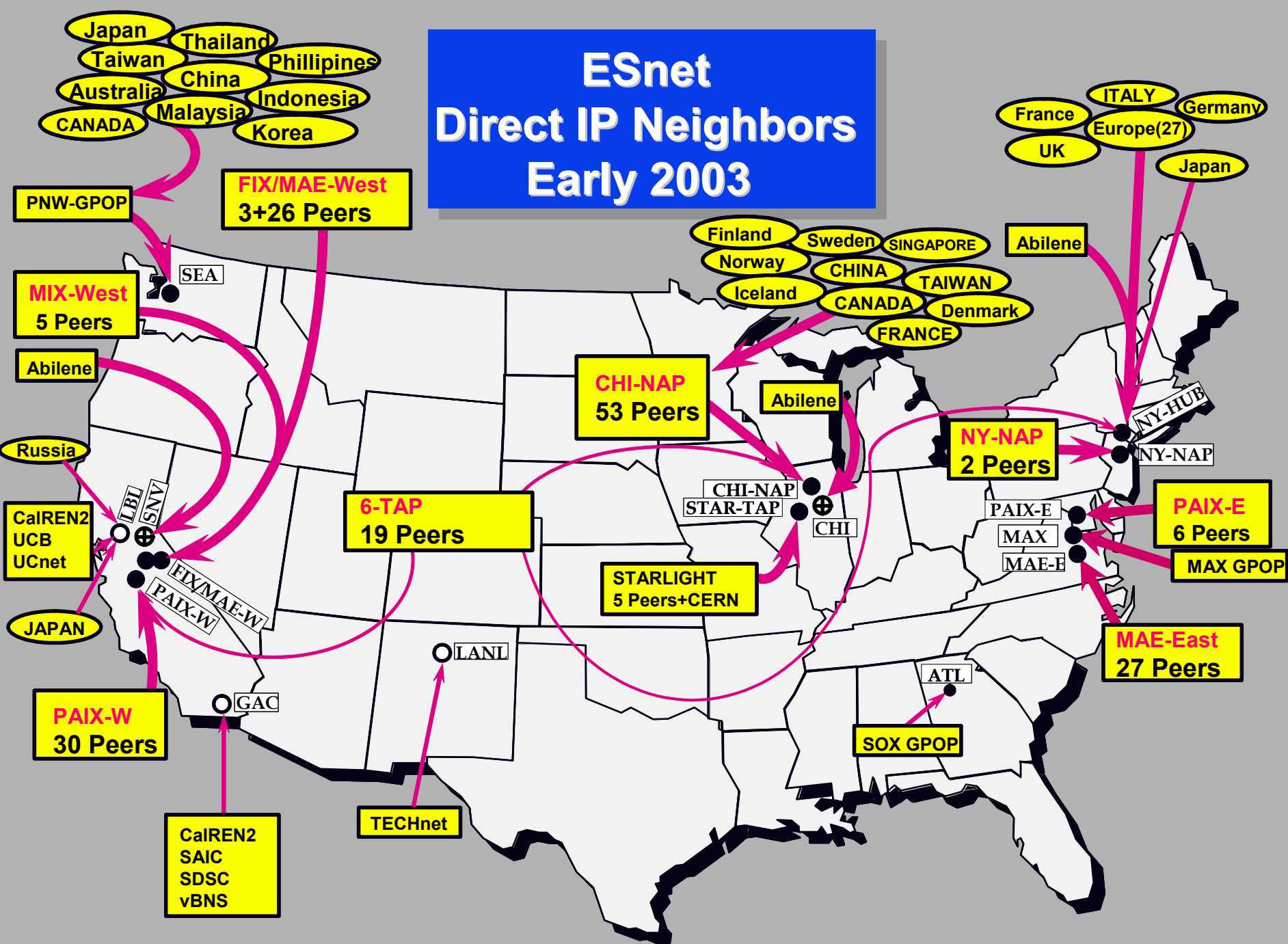
T1-T3

T1

R&E network connections



# ESnet Direct IP Neighbors Early 2003



# Are We Done?

- ESnet is well positioned with backbone capacity for the next 3-4 years
  - It should prove adequate to meet projected and anticipated traffic growth
  - OC768 deployment is currently beyond the scope of the current contract and planning
- The next “bottleneck” becomes the individual site connections
  - LBNL and NERSC are connected at OC48
  - All others are at OC12 or below
  - Local access circuits are expensive and not as subject to pricing pressures as long-haul



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# Other Services

*from the Report of the ESnet Review Committee*

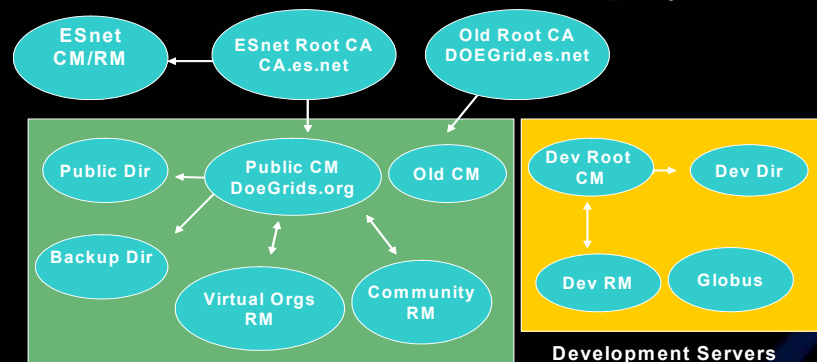
- *“... Additionally, a collection of new methodologies for distributed storage and computation is emerging from the discipline-specific and computational science communities. The capabilities and services made possible by these new techniques- collectively and loosely filed under the “Grid” paradigm – will be expected by ESnet users, and this requirement will presumably be communicated to ESnet via the traditional mechanisms. ...”*

# Other Services

- We provide other “core” services in support of DOE science
  - Our ISDN video conferencing center supports over 100 hours/day of meetings!
  - Our audio bridge is even more busy
  - We are now piloting “ad-hoc” H-323 videoconferencing which has been very well received, delivering about 500 Conf-hours/month.
- We are also piloting a set of services and servers needed to support the Public Key Infrastructure required in DOE Grids deployment for authentication
  - This has been another example of “social engineering” proving to be much more difficult than the technical engineering!
  - But has been very successful to date

Counts of Conferences in All Resources Starting 10-01-2002 and Ending at 11-01-2002		
Number of Conferences	1342	This is the total number of conferences during the time period specified in the selected rooms.
Conference Hours	2405.5	This is the sum of the lengths of all the selected conferences.
Audio Bridge Port Hours	4228.5	This is the sum of ( conference length times the number of audio bridge ports ) of all the selected conferences.
Data Bridge Port Hours	45	This is the sum of ( conference length times the number of data bridge ports ) of all the selected conferences.
MCU Port Hours	5251	This is the sum of ( conference length times the number of MCU ports ) of all the selected conferences.

## Architecture for 10/15/02 deployment



DOEGrids Production Servers

Development Servers

CM: Certificate Manager  
RM: Registration Manager  
Dir: LDAP based Directory

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# A White Paper

## A Vision for DOE Scientific Networking Driven by High Impact Science

A White Paper  
prepared at HQ request  
By  
W Johnston, W Kramer, J Leighton

# Background

- Originally proposed/requested a 2-5 page whitepaper on a networking strategy for DOE
  - Extends beyond current scope of ESnet
  - One goal was better integration of network production, research, application components
- Paper presented to MICS staff on 15 March.

# Vision and Approach (1/2)

- Emphasis on connection with “high impact” science
- Contains 3 network facility components
  - Production network
  - Pilot Network
  - Testbed Network
- Advanced services emphasized
- Enhanced means to introduce new network technology

# Vision and Approach (2/2)

• Table 1.1

## Characteristics of the Networks

This table indicates some of the basic differences of the three networks

• Service Characteristic	• HPPN Network	• ASAP Network	• ANTCT Network
• Bandwidth relative to current ESnet	• 4 times i.e., 2.5 Gbps	• 16 times i.e., 10 Gbps	• Defining characteristics will probably be different network architecture, protocols, etc.
• Number of sites	• 30–50	• 4–6	• Determined opportunistically
• Maturity of applications	• Full range of production applications	• Limited set of early adapter applications	• Experimental applications and application kernels
• Reliability	• 99.9%	• 95-98%	• 50-80%
• Mean time between failure	• Months	• Weeks	• Days
• Mean time to repair	• 2–4 hours	• Next business day	• Days to weeks



# A Workshop

**Report of the  
High Performance Network Planning Workshop  
August 13-15, 2002  
Reston, VA**

Ray Bair

## High Priority Middleware Research Areas

- Secure control over who does what
- Information integration and access
- Coscheduling and quality of service
- Effective network caching and computing
- Services to support collaborative work
- Monitoring and problem diagnosis

## High Priority Network Research

- Ubiquitous monitoring and measurement infrastructure
- High-performance transport protocols
- Multicast
- Guaranteed performance and delivery
- Intrusion detection
- Distributed systems vs. firewalls

## SC needs integrated Network Provisioning and Governance Models

1. Production Level Networking
  - In support of base DOE science requirements
2. Resources for High Utilization Science
  - In support of challenging science applications
  - Providing both capability networking and advanced services
3. Resources for Network Research
  - Easily separable for running controlled experiments

Over time, services, capabilities and app's migrate

## A Path Forward

- 1
  - **Analyze requirements**
    - Vet against program office opportunities and computing/data growth realities
  - **Evaluate infrastructure opportunities**
    - Address the 3 elements
    - Short (1 yr) + long (5 yr) integrated strategy
- 2
  - **Develop a roadmap**
    - The big picture, across programs and infrastructure elements
    - Each major science initiative incorporates program-specific parts
  - **Position the enterprise**
    - Take first steps on time-critical elements
    - Align research programs
    - Migrate network governance model

# Part 1

- Conclusions/Observations
  - ESnet is now well positioned for backbone capacity over the next 3-4 years assuming traffic growth rate remains at historical growth rates
  - The cost of meeting demand for additional capacity will eventually out-strip a flat budget
  - The next bottleneck in meeting demand will be site connectivity
  - New services are being developed
  - New approaches are being considered

# TOPICS

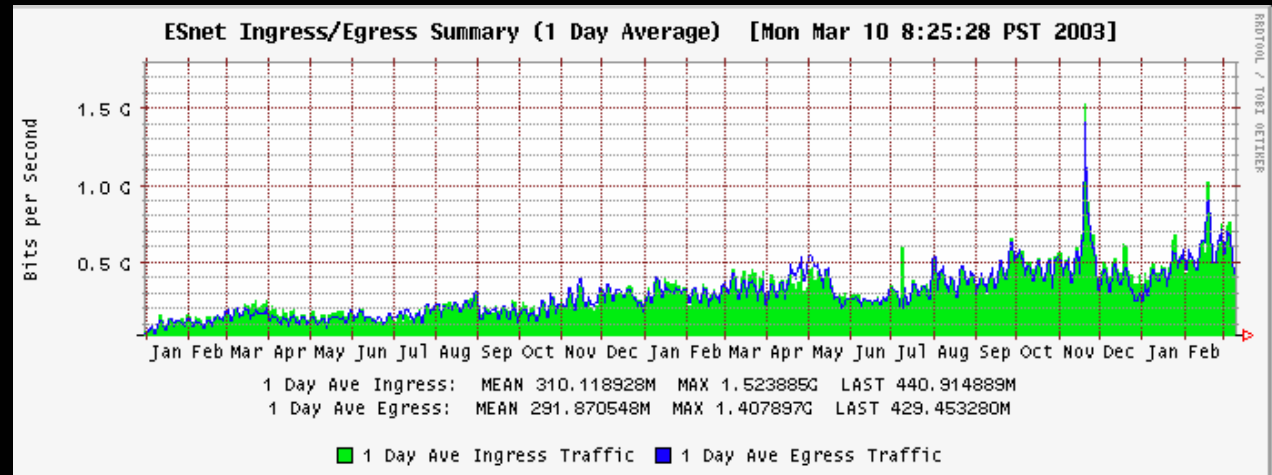
- PART I: Meeting Requirements
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# Traffic Overview (1/4)

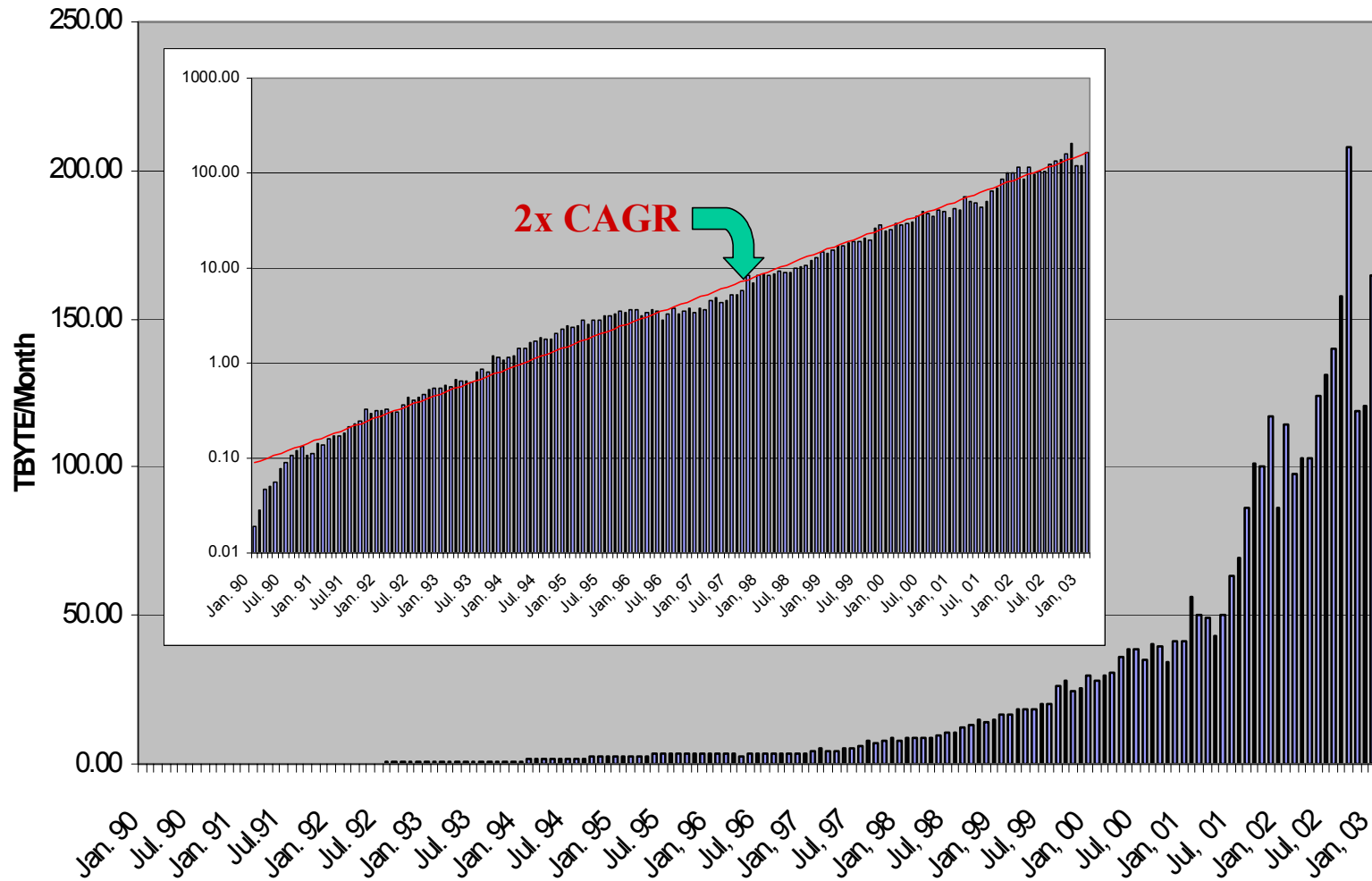
- Feb, 2003
  - 279 Gpackets accepted
  - 165 Tbytes accepted
  - 591 Bytes/packet (Average Packet Size)



- Feb, 2002
  - 93.0 Gpackets accepted
  - 86.1 Tbytes accepted
  - 922 Bytes/packet (Average Packet Size)

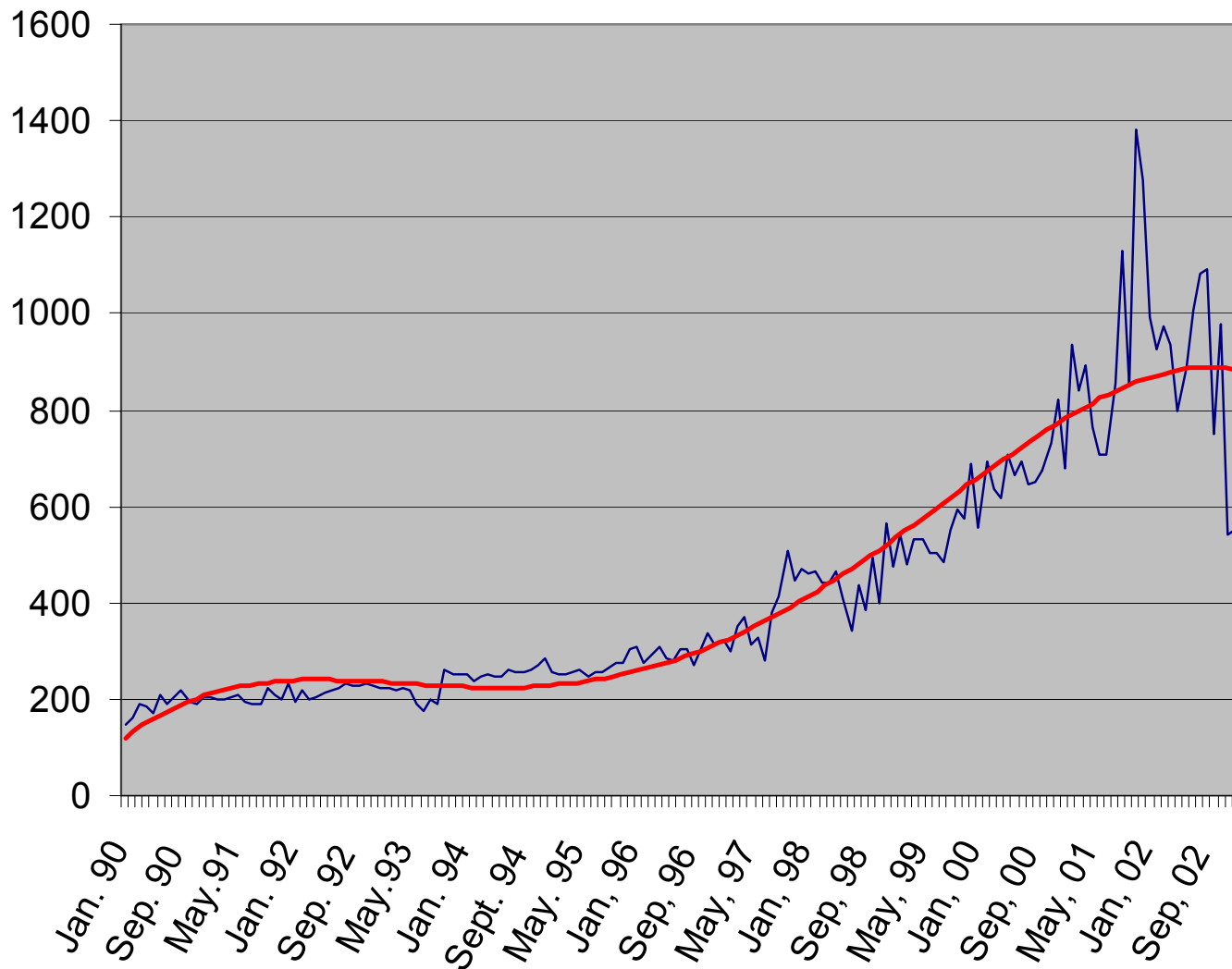
# Traffic Overview (2/4)

ESnet Monthly Accepted Traffic



# Traffic Overview (3/4)

**ESnet AVG BYTES PER PACKET**





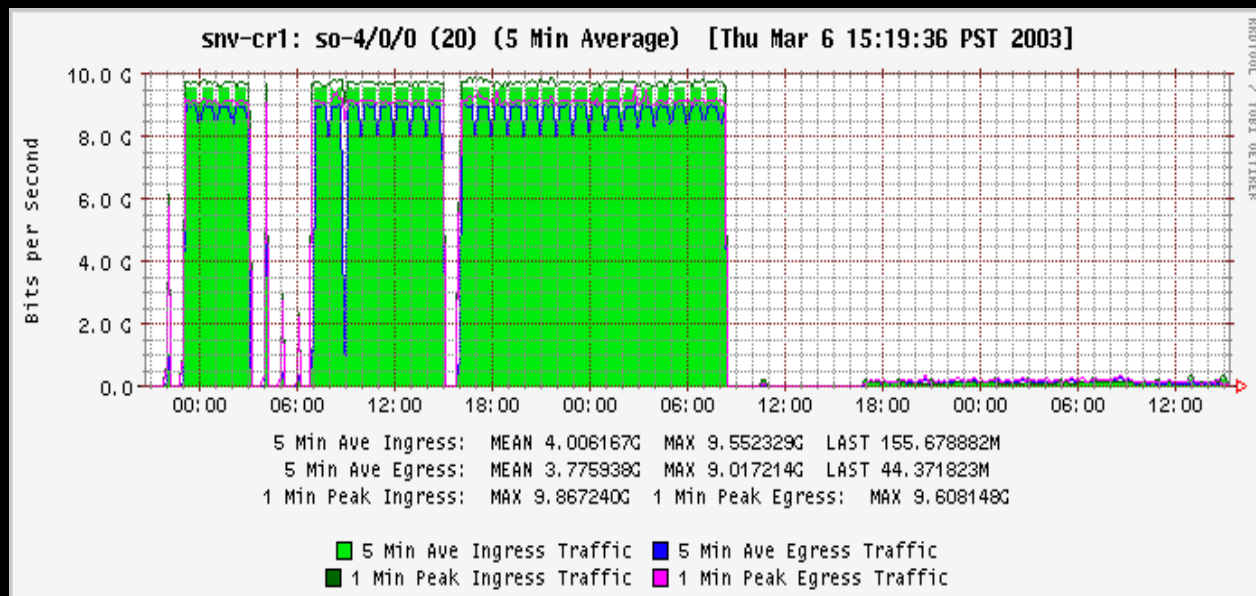
# TOPICS

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# Backbone Transition (1/3)

- The transition to the new OC48/192 backbone completed !
  - Final two OC192 segments brought on-line March 5, 2003
  - A few details remain to be completed
    - ATM SecureNet sites must be moved to the (now) non-ATM backbone

Testing at full  
OC192 rate done  
by “looping”  
1Gbps MPLS  
paths back and  
forth along the  
link



# Backbone Transition (2/3)

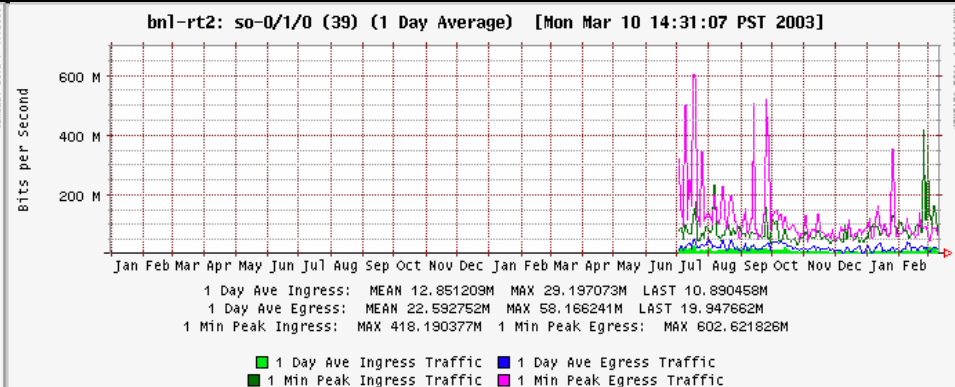
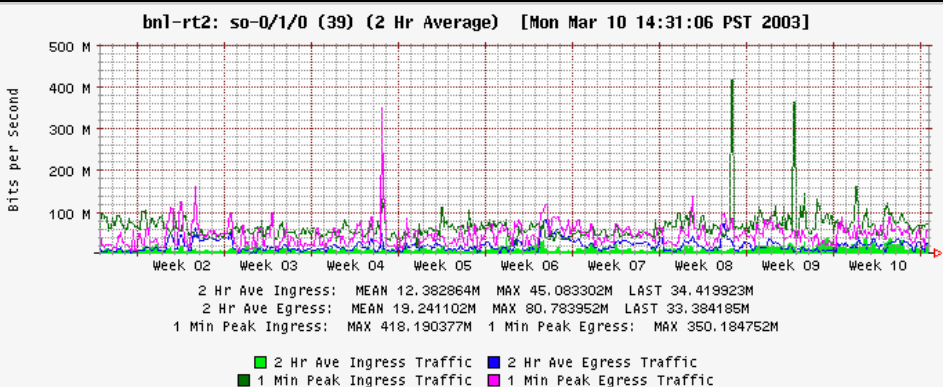
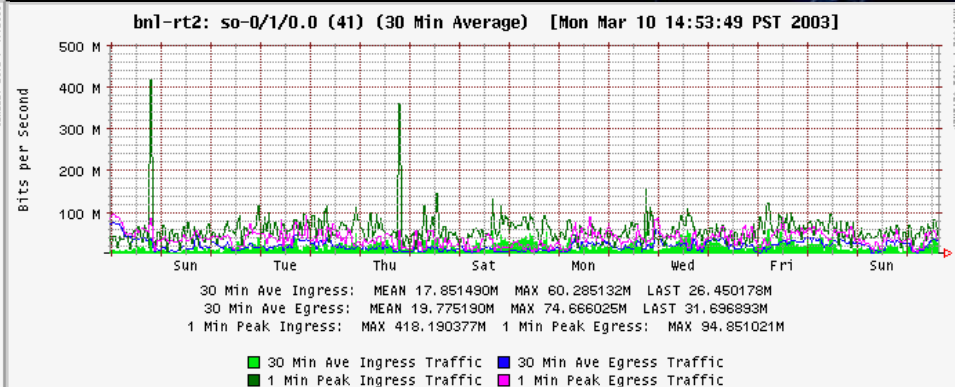
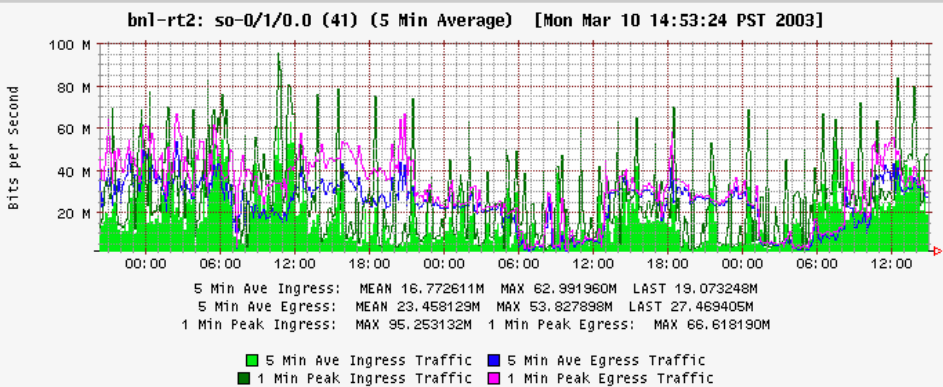
- Hub Changes:
  - We now have six backbone hubs
    - SNV and CHI upgraded to OC192 DWDM capability
    - NY: Moved from 60 Hudson to 32 AOA and upgraded to OC192 DWDM capability
    - DC, ATL, ELP: Upgraded to OC48 DWDM capability and connected directly onto the backbone
    - ORN: Eliminated
    - All inter-hub ATM and SONET links eliminated
- “Sub-Hub” Changes:
  - GA and Seattle will have ATM in the OC3 access circuits eliminated – i.e. moving from ATM access to SONET access (eliminating the ATM overhead, AKA “cell tax”)

# Backbone Transition (3/3)

- Site Changes:
  - LLNL and Sandia/CA upgraded OC12 access via SNV hub
  - LBNL and NERSC upgraded to OC48 access via SNV hub
  - FNAL upgraded to OC12 via CHI hub
  - MIT, BNL, PPPL moved to new NY hub location
  - ORNL moved to new ATL hub
  - LANL and Sandia/NM moved to ELP hub (by way of ALB sub-hub)
  - SRS to be moved from T3-ATM to T3 pt-pt connection via ATL hub
  - PANTEX upgraded to OC3 ATM access via ELP hub
  - KC/Honeywell to be upgraded to OC3 ATM via ELP hub

# Site Access (1/5)

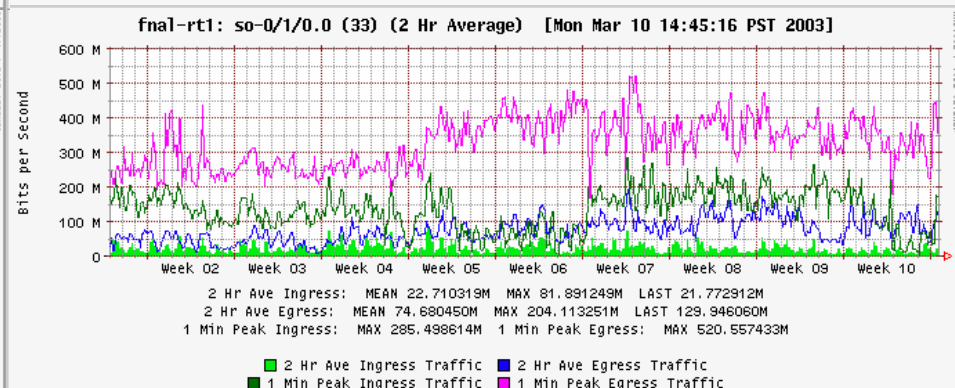
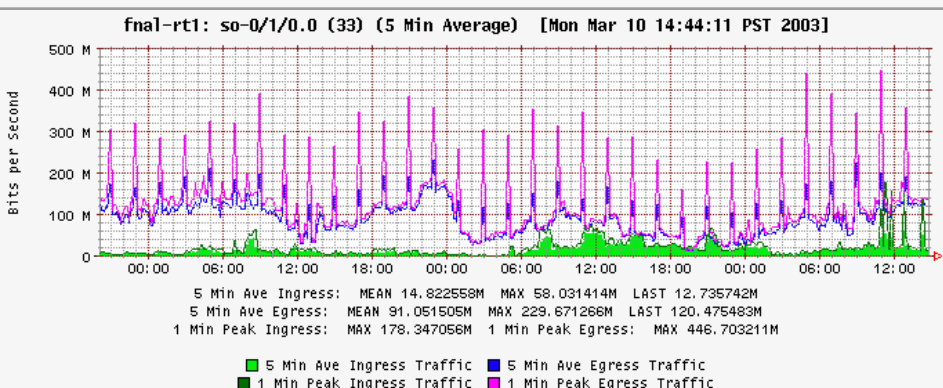
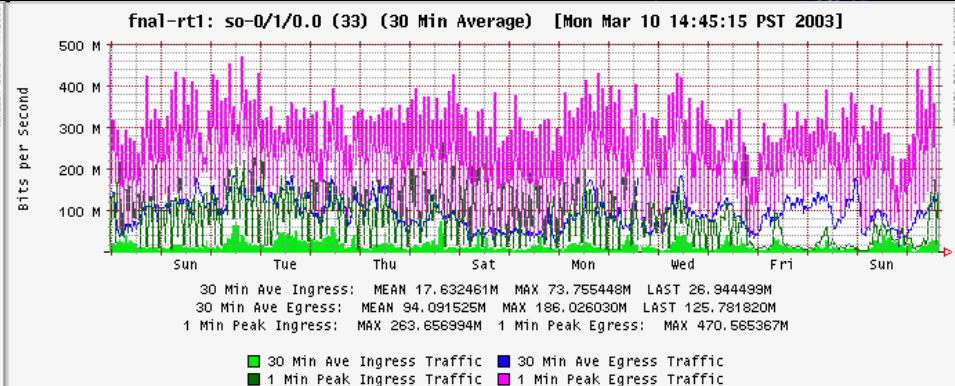
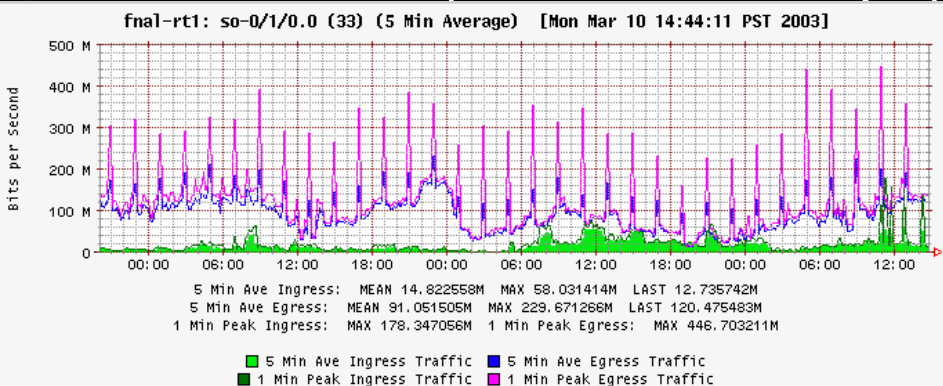
- Access Considerations
  - BNL (OC12 = 622Mbps)





# Site Access (2/5)

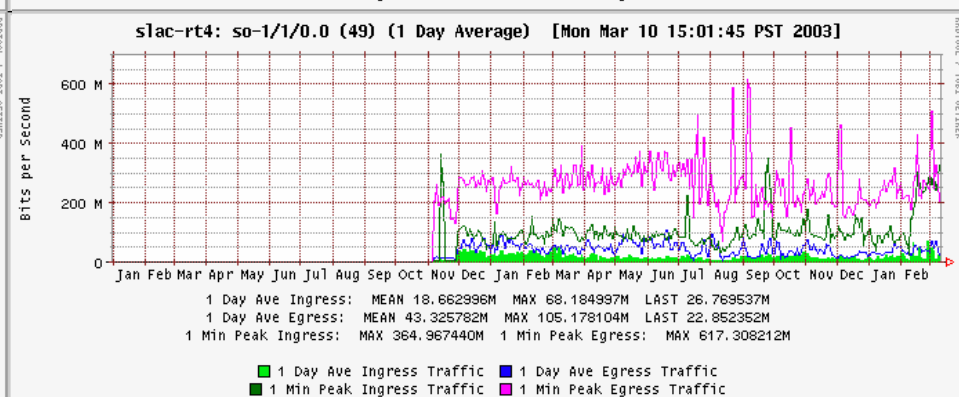
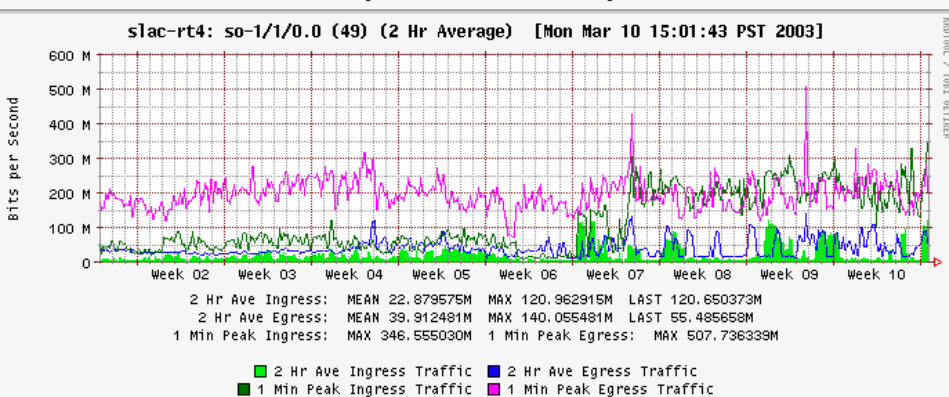
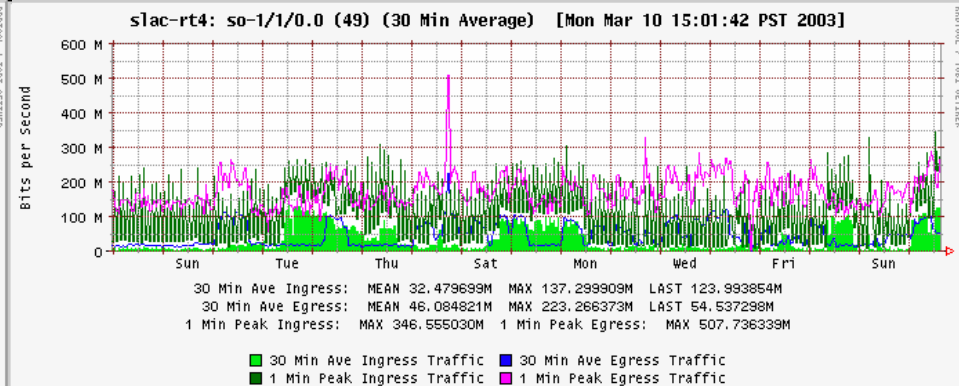
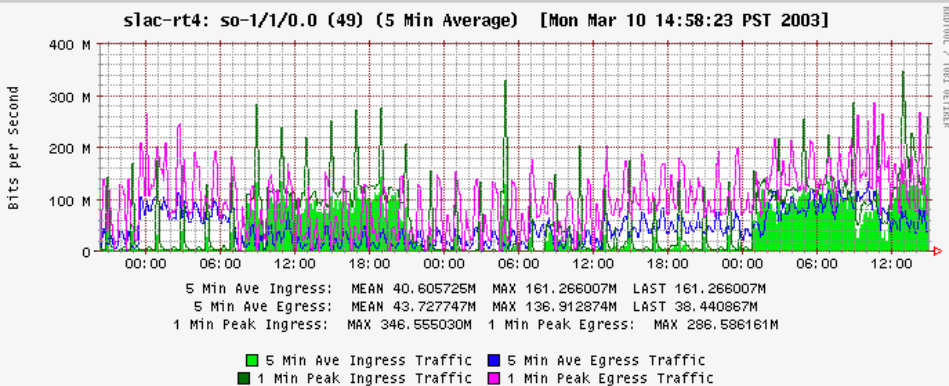
- Access Considerations
  - FNAL (OC12=622Mbps)



- Have plans for dark fiber to STARLIGHT as alternate path to ESnet under consideration

# Site Access (3/5)

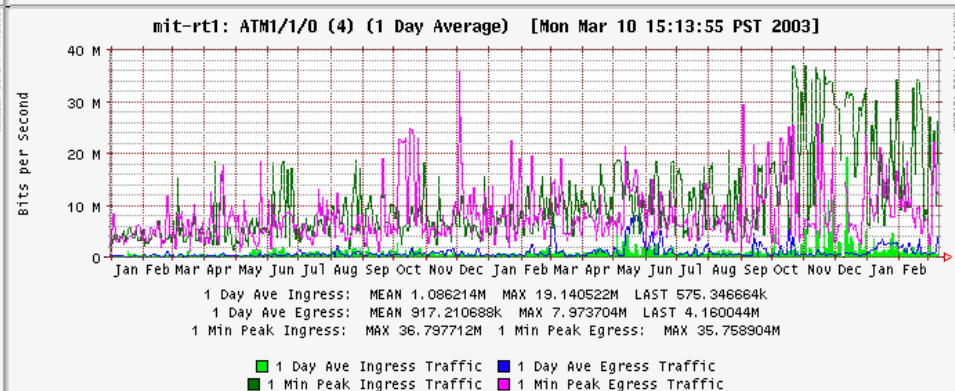
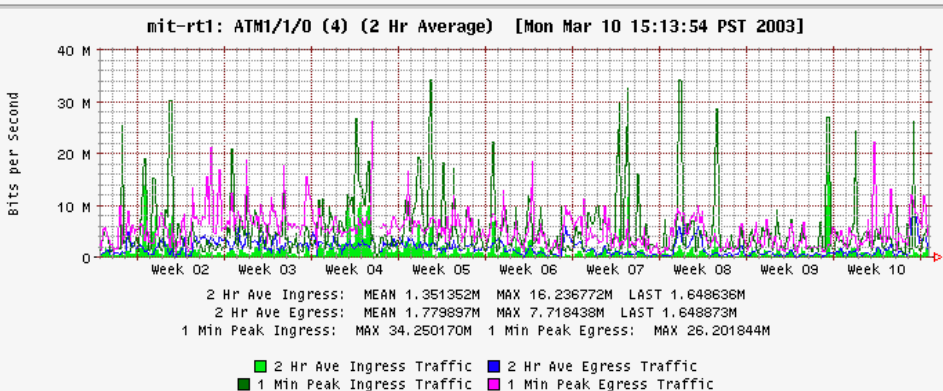
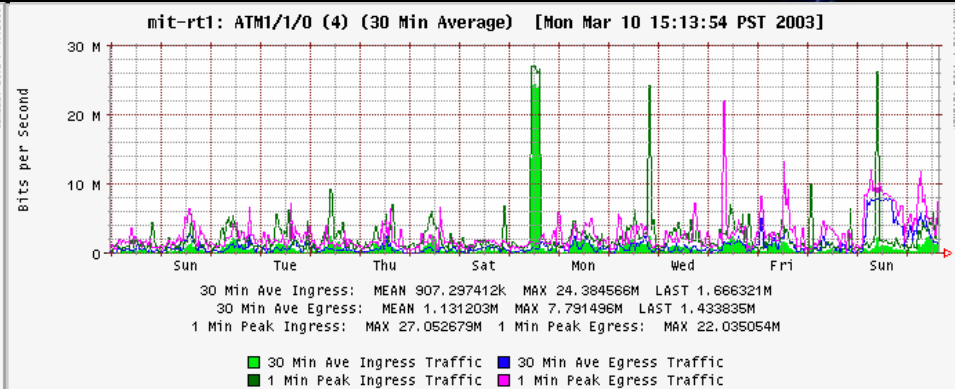
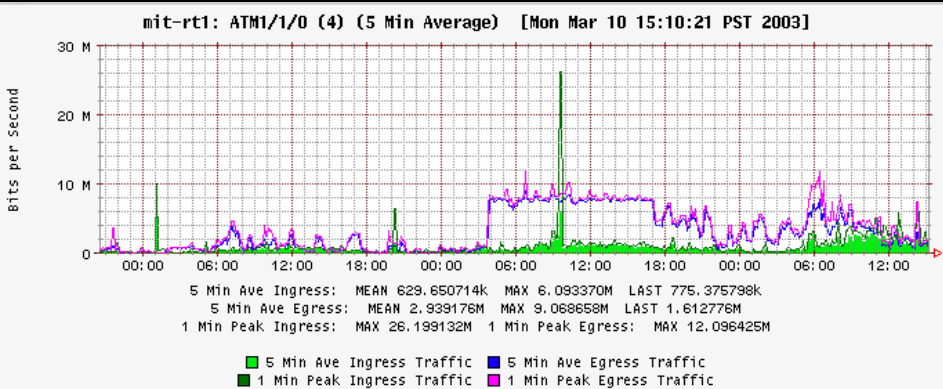
- Access Considerations
  - SLAC (OC12)



- Will move BaBar traffic back to ESnet once OC192s trunking and OC48 to DANTE in place

# Site Access (4/5)

- Access Considerations
  - MIT (T3=45Mbps)

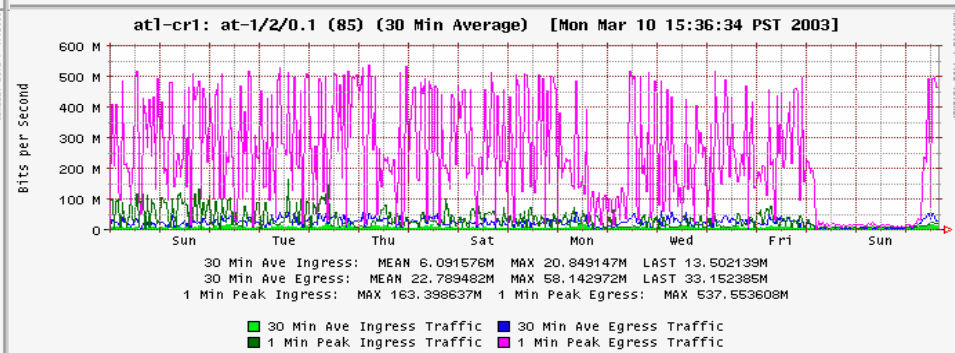
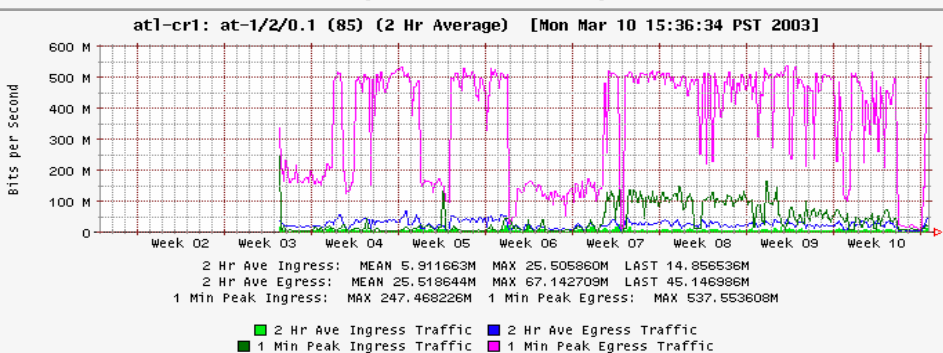
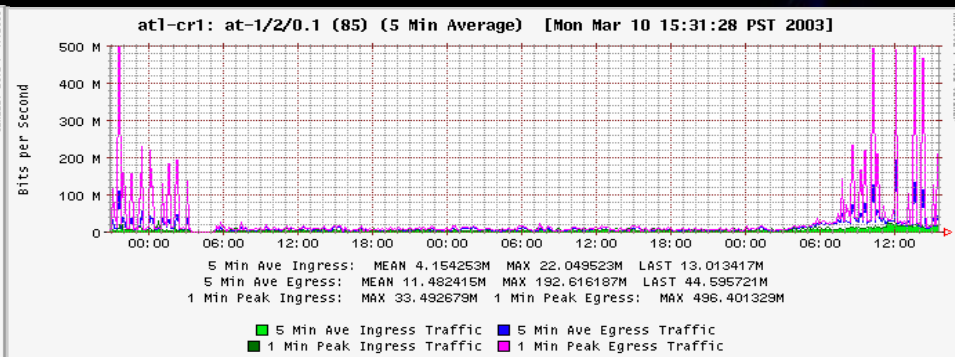
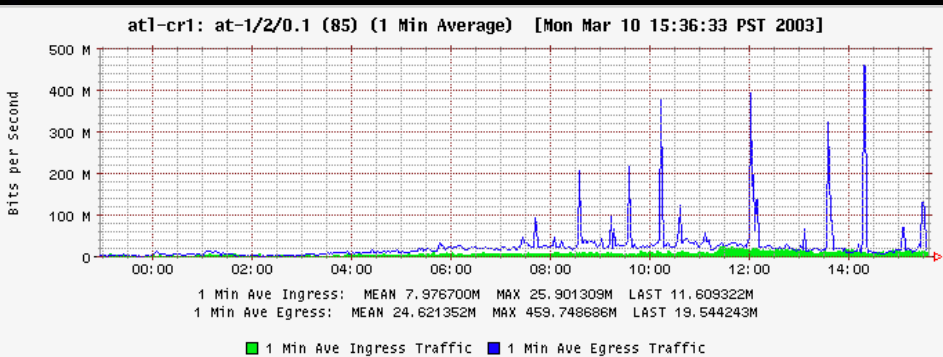


- Cost to upgrade is relatively high



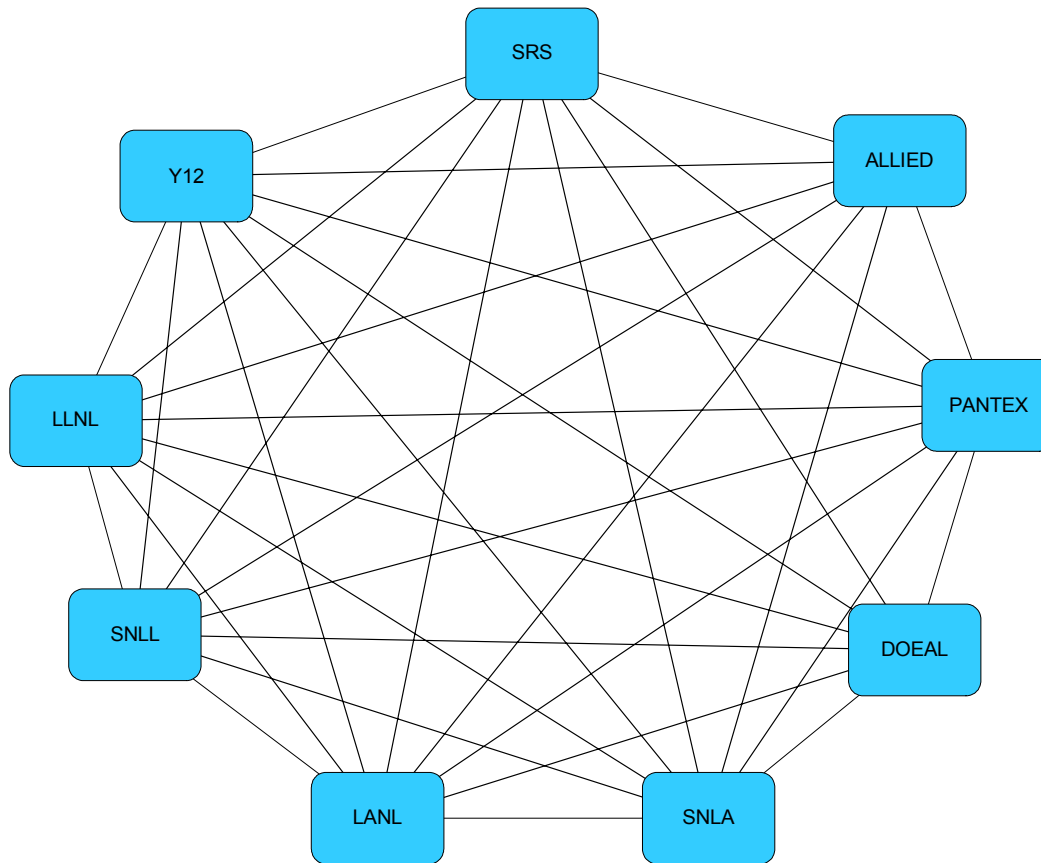
# Site Access (5/5)

- Access Considerations
  - ORNL (OC12=622Mbps)



# SecureNet Transition (1/5)

## SecureNet Logical Connectivity



A full mesh of ATM PVPs

## SecureNet Migration

- ATM in the core is going away
- Still need to support ATM encryptors
  - End to end ATM connectivity required
  - Logical full mesh of PVPs must be preserved

Solution: Junipers Circuit Cross Connect functionality aka CCC

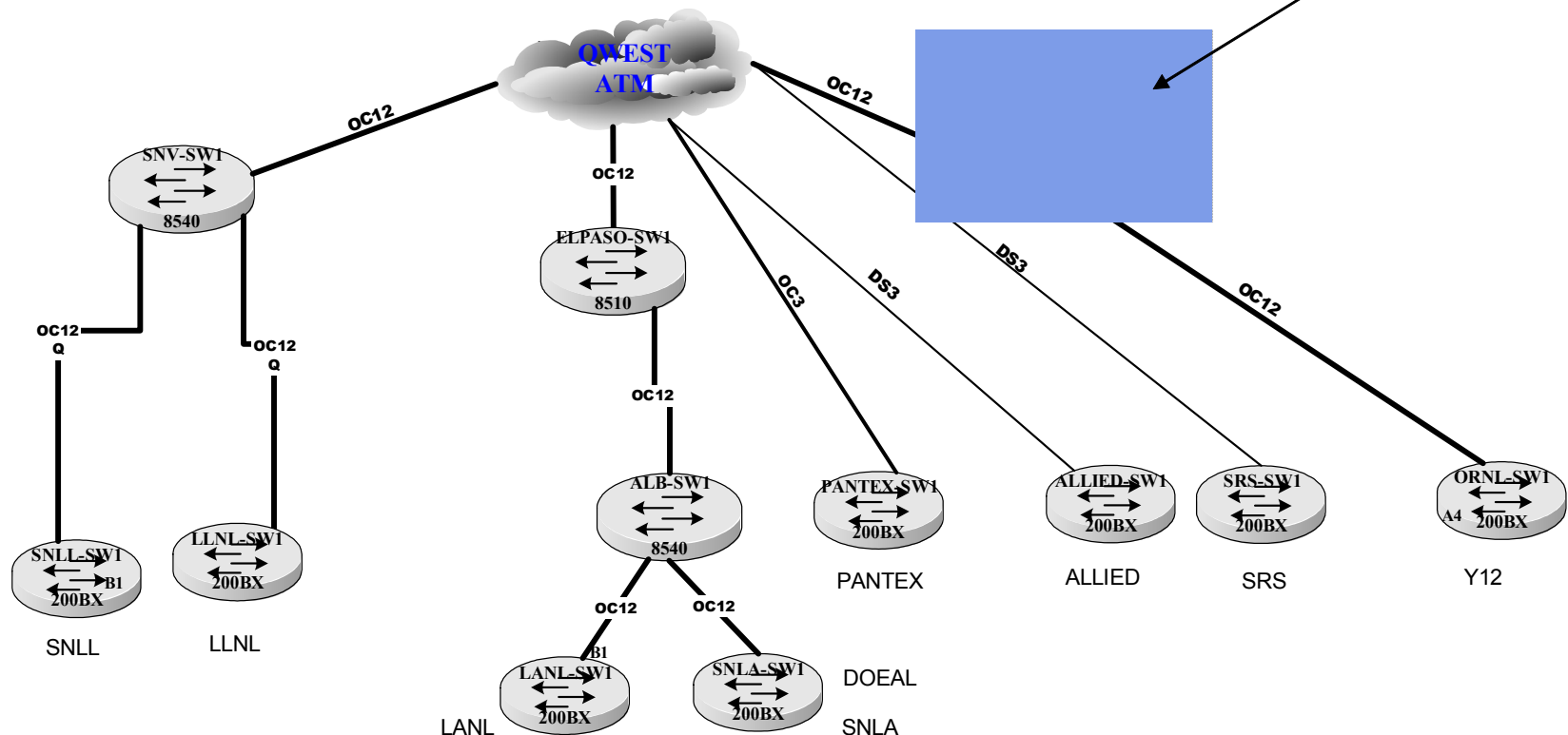
## What is CCC

- Provides a transparent connection between two like interfaces on Juniper Routers
- Interfaces may reside in the same **or disparate** routers
- Connection between distant interfaces accomplished via MPLS

# SecureNet Transition (4/5)

## SecureNet Topology: Current

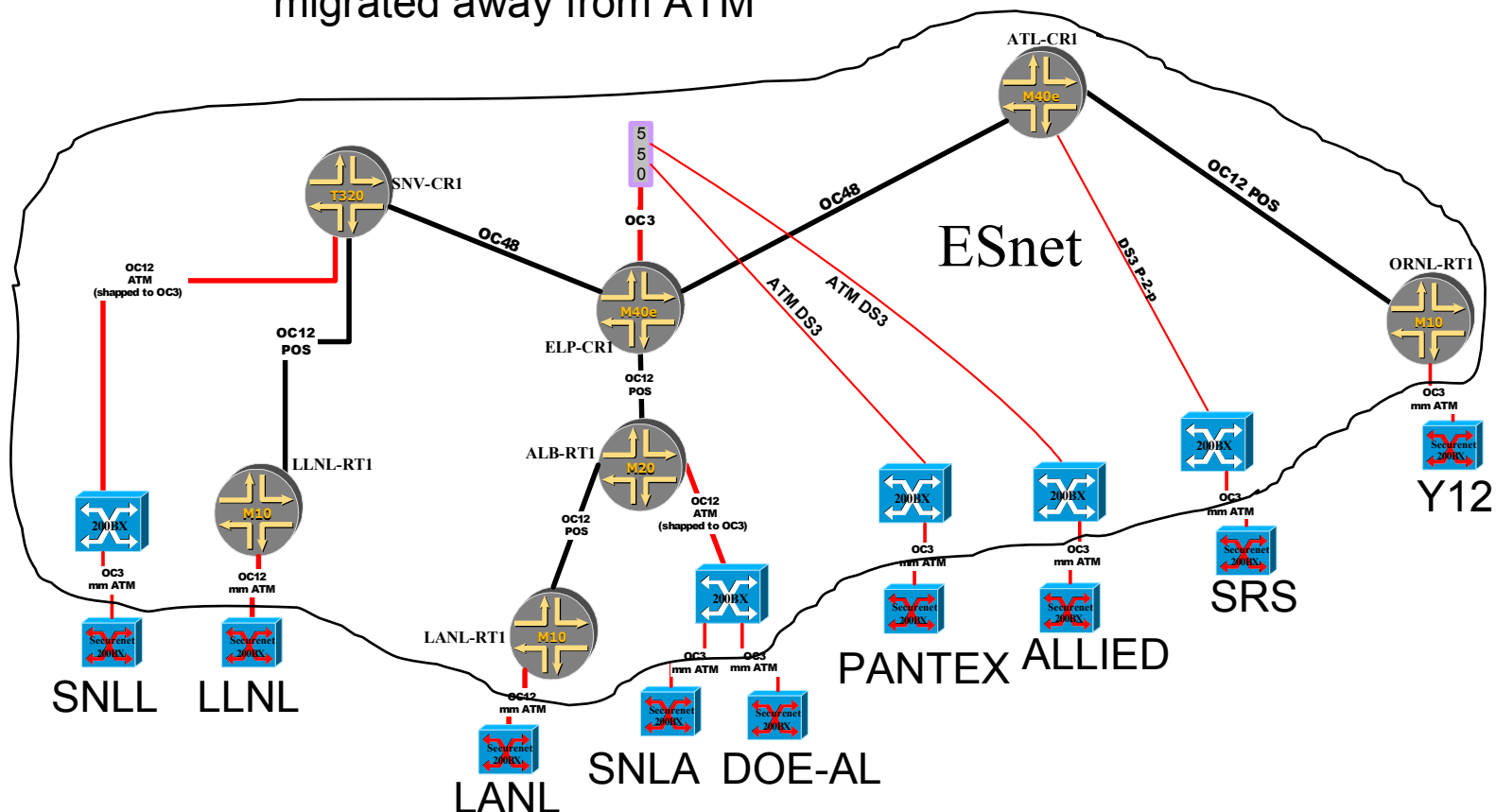
Note the missing ATM switch!



# SecureNet Transition (5/5)

## SecureNet Topology: Final Topology

Where appropriate, site local loops are migrated away from ATM



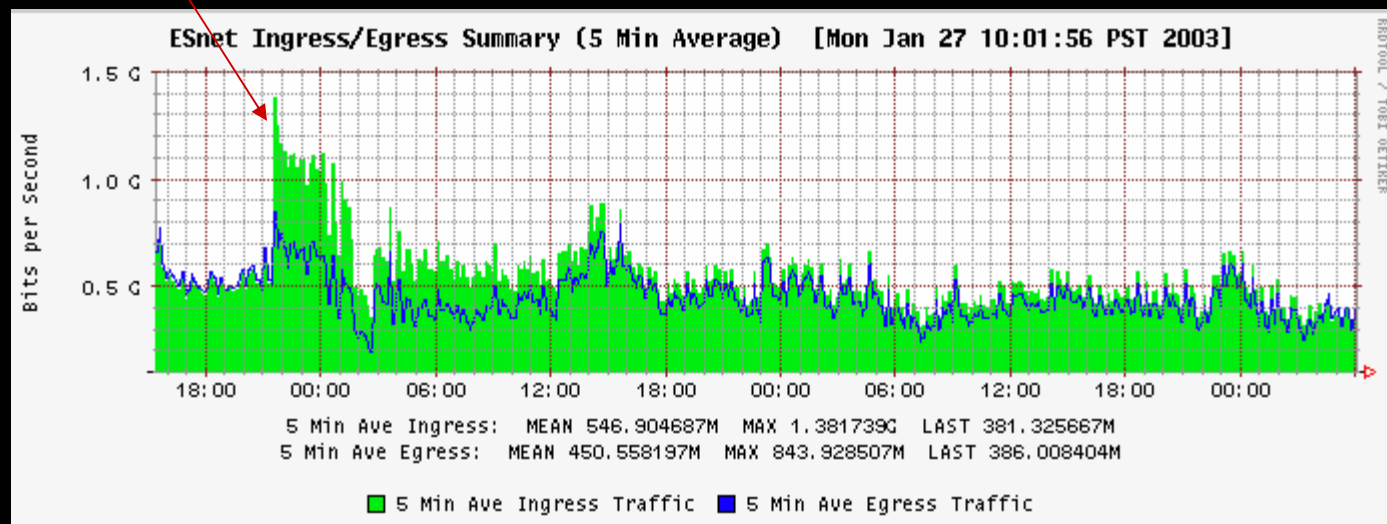
# SQL Worm (1/2)

The below shows total traffic for ESnet. Green shows all traffic in-bound to ESnet and the blue line shows all traffic outbound from ESnet.

This does show that ESnet continued to function during the attack, while filtering out the traffic propagating the attack. Four small ESnet routers were impacted and needed to be reloaded resulting in downtime for some segments of the network

The ingress traffic that exceeds the egress traffic is most likely worm-generated traffic without a routable address, which thus is accepted ( as ingress traffic) and then subsequently discarded by the network, therefore not showing as egress traffic.

Worm infection hits





# SQL Worm (2/2)

The below shows traffic at a site router. Dark Green shows all traffic in-bound to the router (in this case the local LAN traffic) and the blue line shows traffic outbound on the link to ESnet.

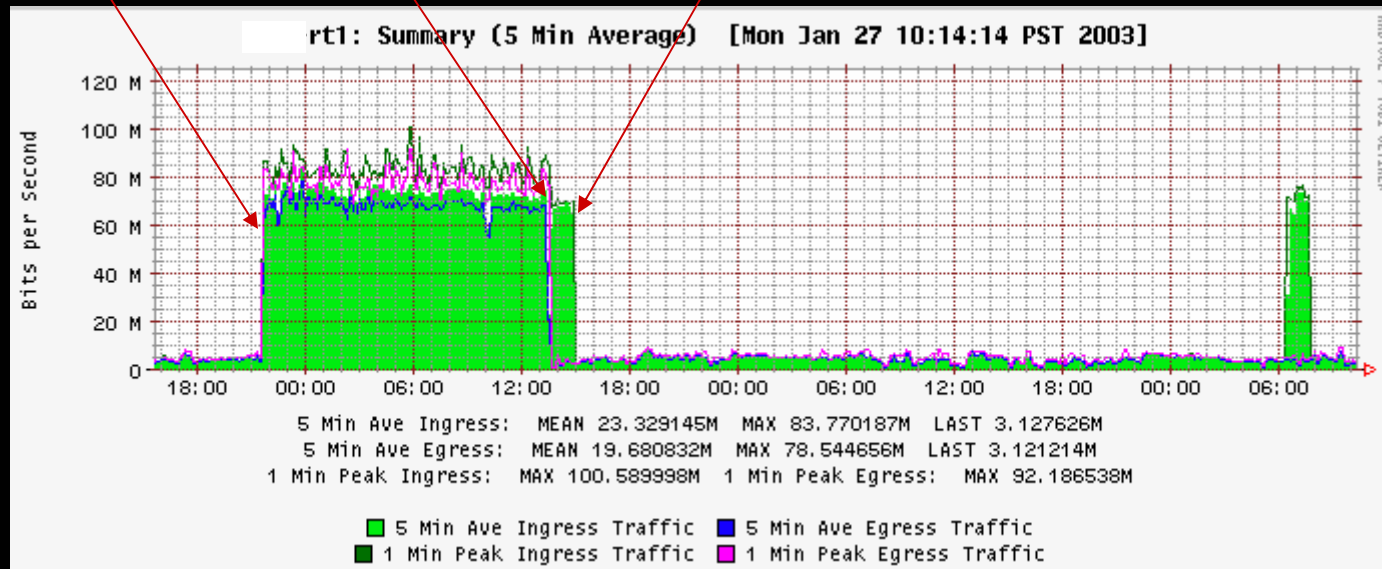
The amount of traffic would indicate possibly several systems infected.

Forwarded data was filtered at the backbone by ESnet. After determining that the site was not responding to the attack, ESnet applied filtering at the site.

Worm infection hits

ESnet applies filters at site router

Site staff responds





# TOPICS

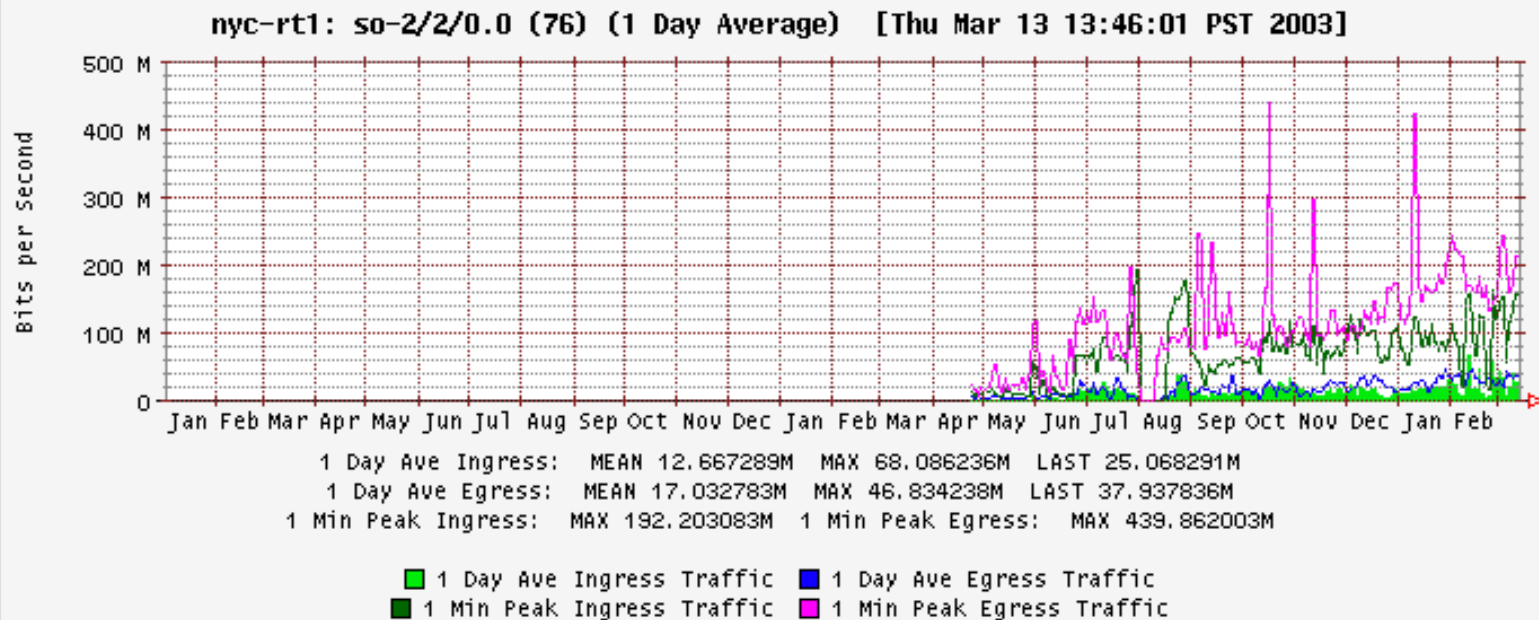
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# 32 AoA (1/2)

The international peering in NY will include DANTE/GEANT (27 European Countries) and SINET (KEK+NIFS).

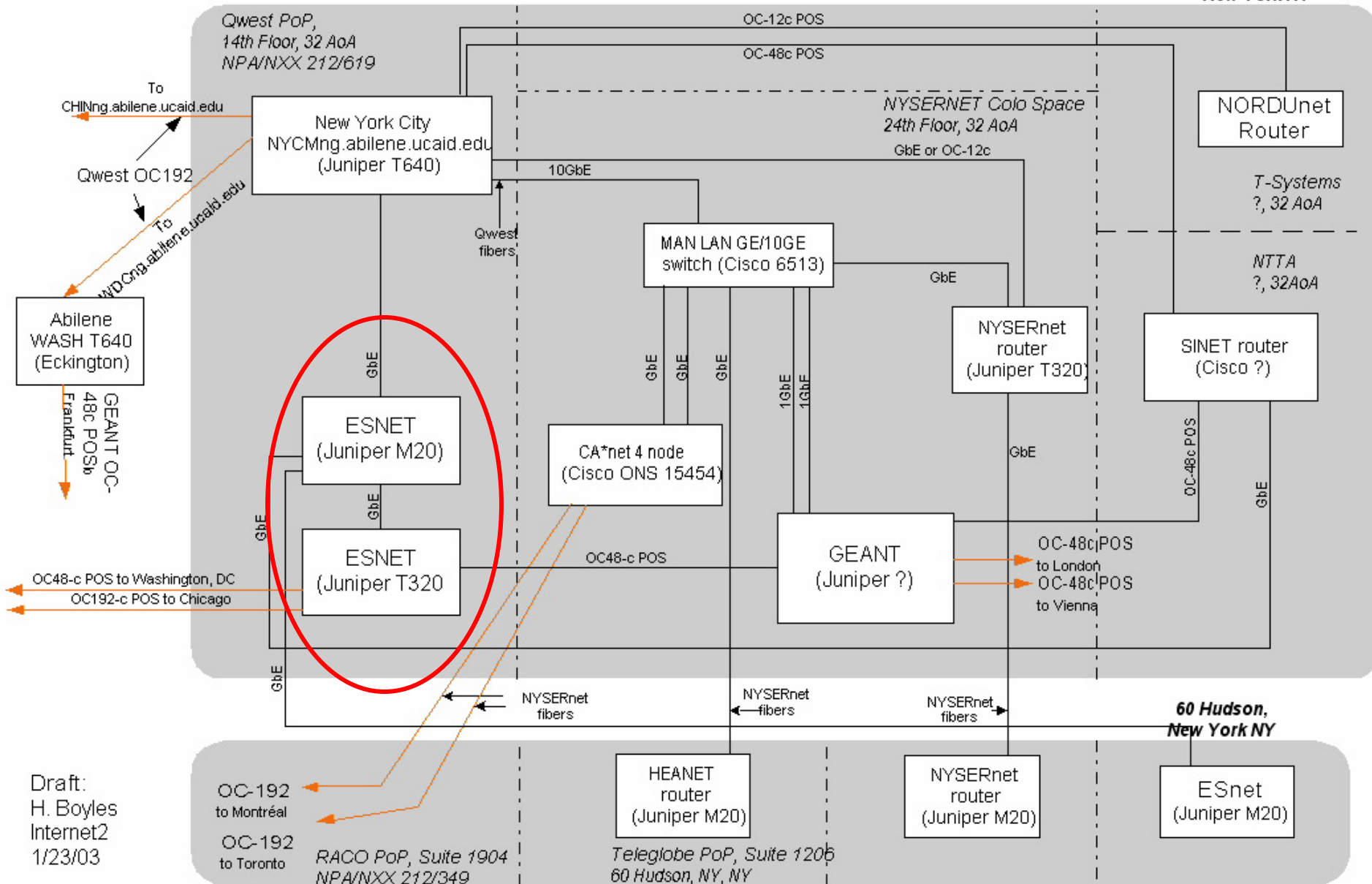
We are planning an OC48 interconnect with GEANT and a 1GbE interconnect with SINET.

ESnet  
To  
GEANT  
Via  
60  
Hudson



New York City R&E Network Interconnections  
End State (circa June 2003)

**32 Ave of the Americas,  
New York NY**

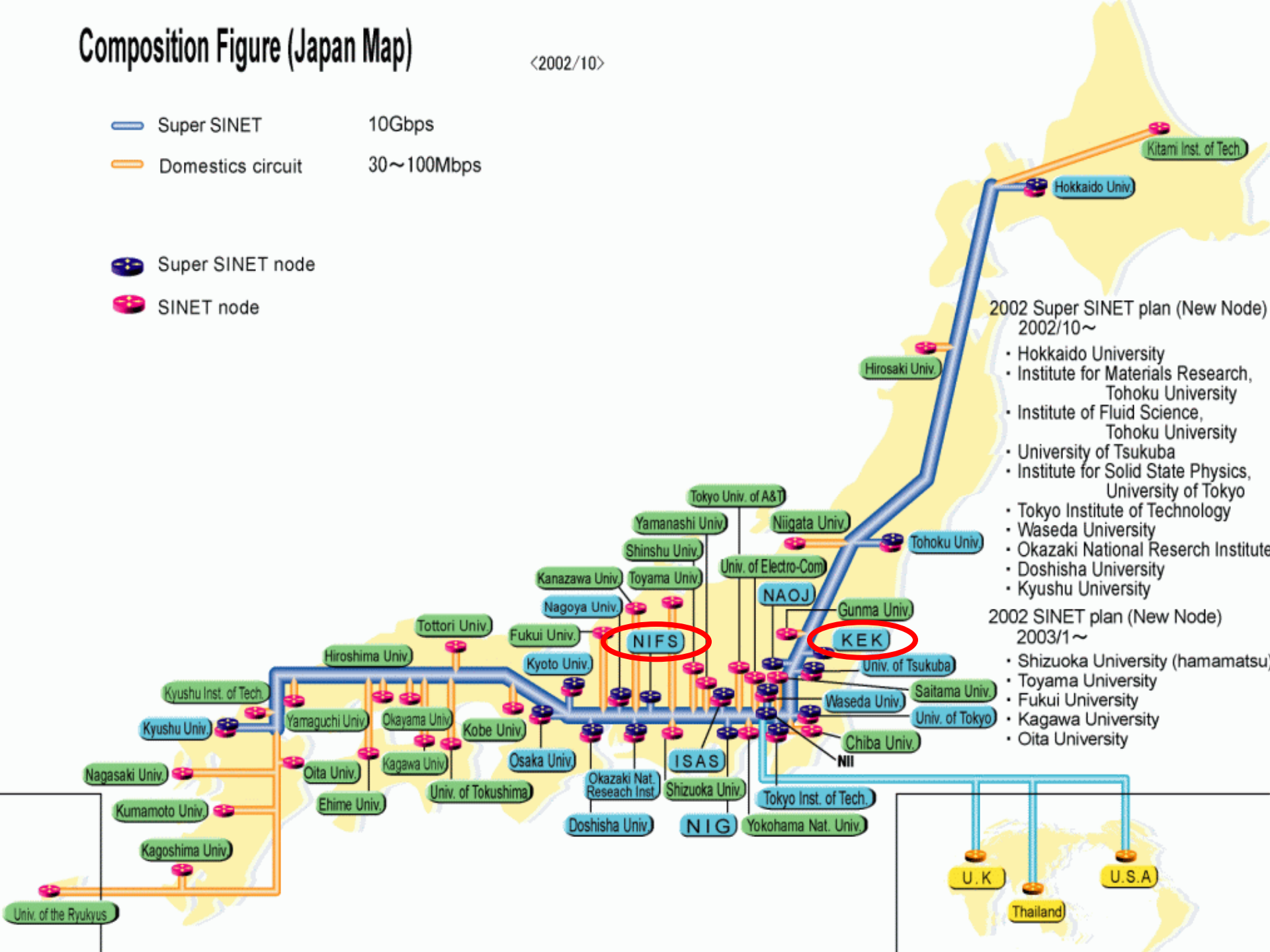


# Composition Figure (Japan Map)

<2002/10>

Super SINET 10Gbps  
Domestics circuit 30~100Mbps

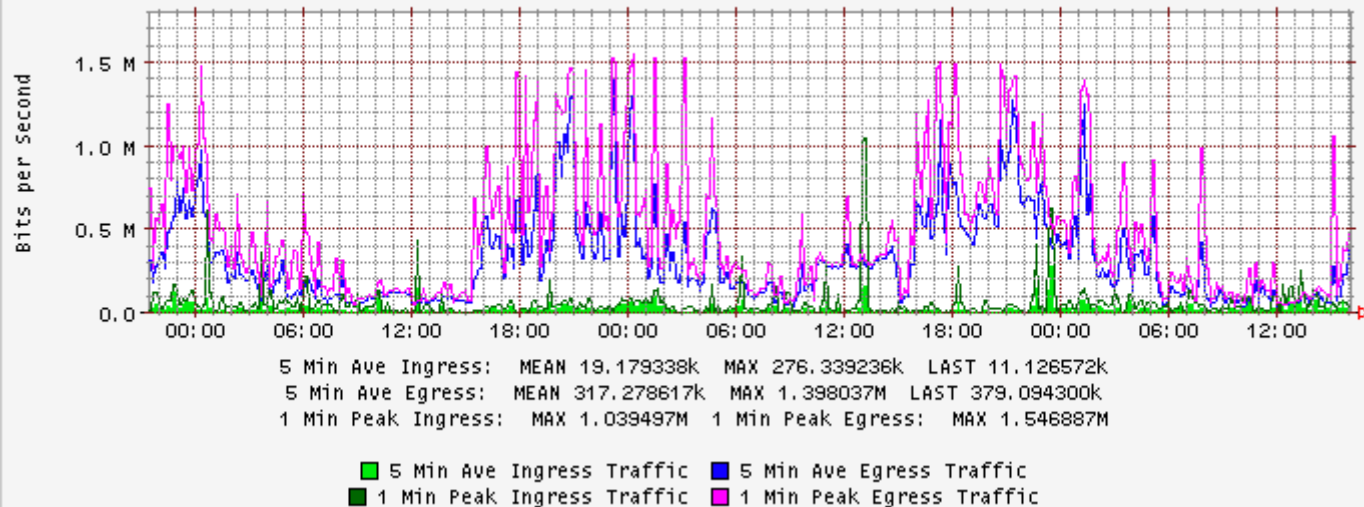
Super SINET node  
SINET node



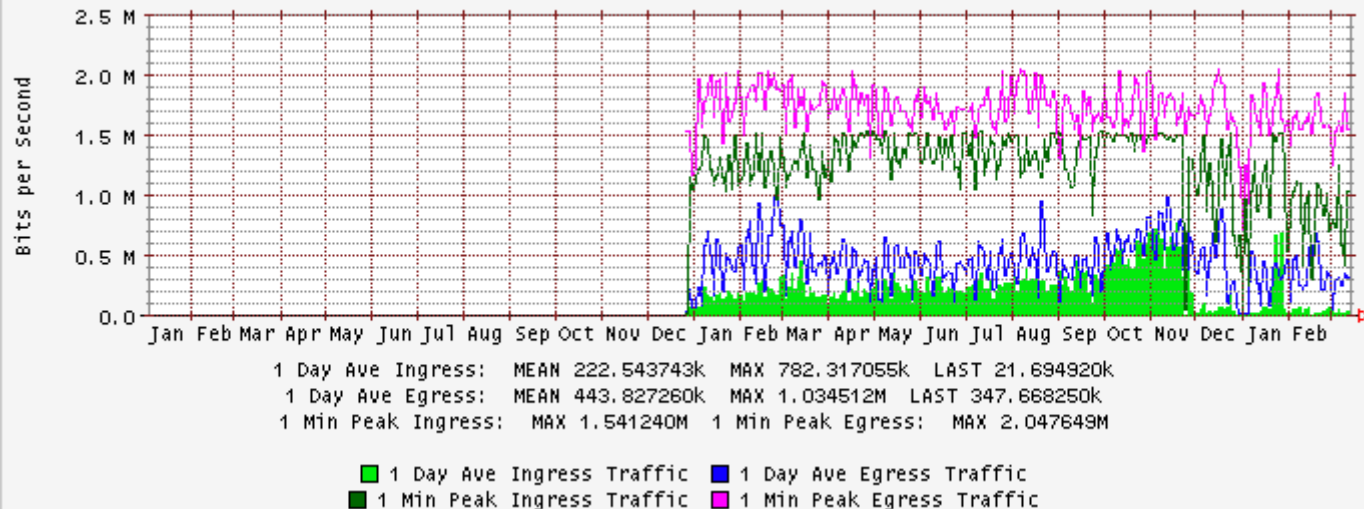
# JAERI Link

ESnet  
To  
JAERI  
Via  
LBL

pacrim-rt1: Serial0/1.1 (7) (5 Min Average) [Thu Mar 13 16:02:06 PST 2003]



pacrim-rt1: Serial0/1.1 (7) (1 Day Average) [Thu Mar 13 16:02:32 PST 2003]



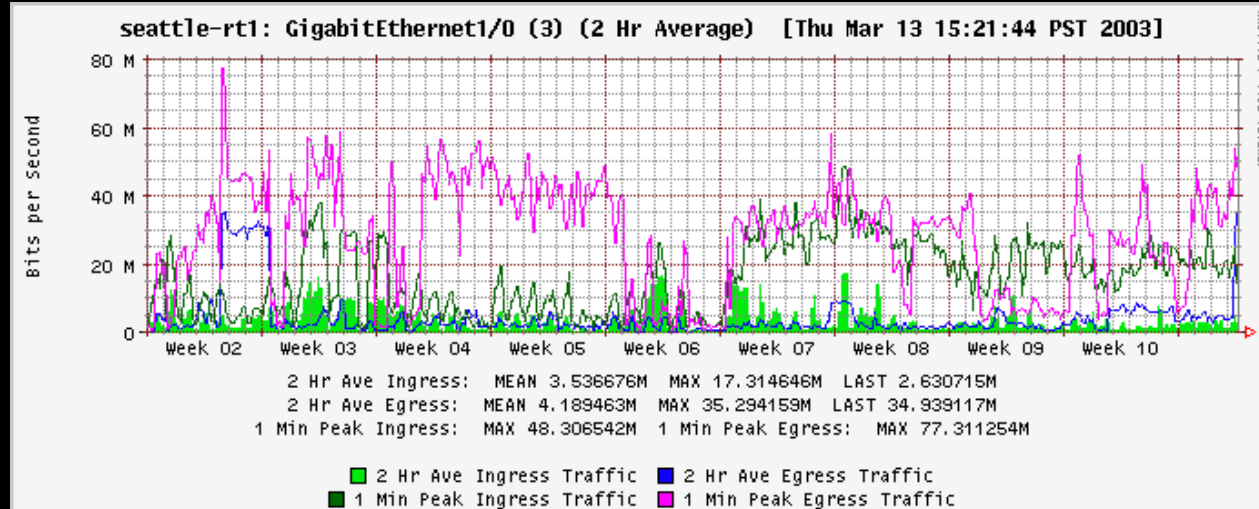
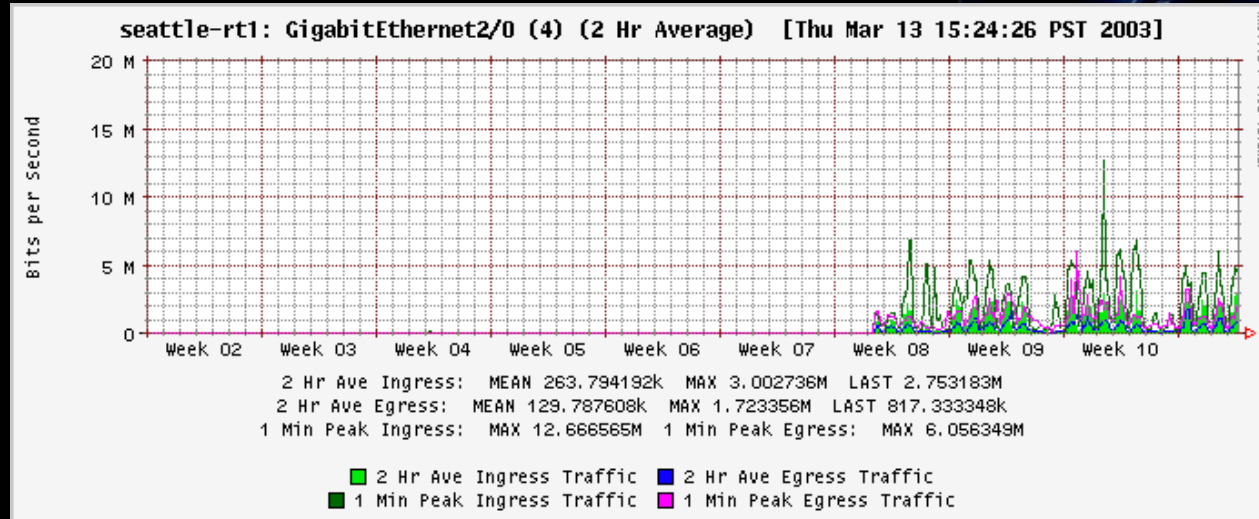


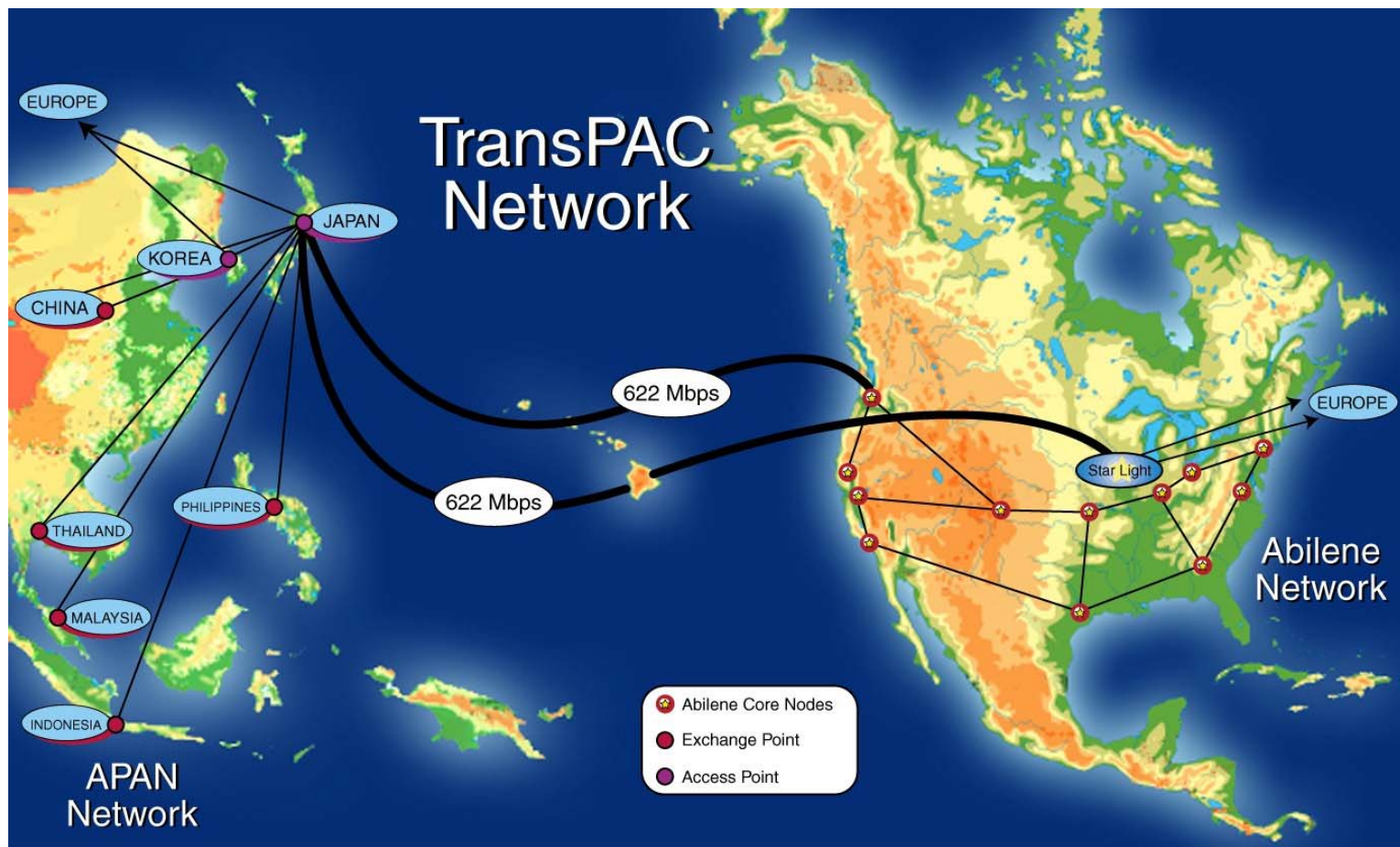
# Seattle

The Seattle sub-hub includes international peering with:

- AARNet
- APAN
- CANARIE
- TANET-12 (Taiwan)
- TRANSPAC

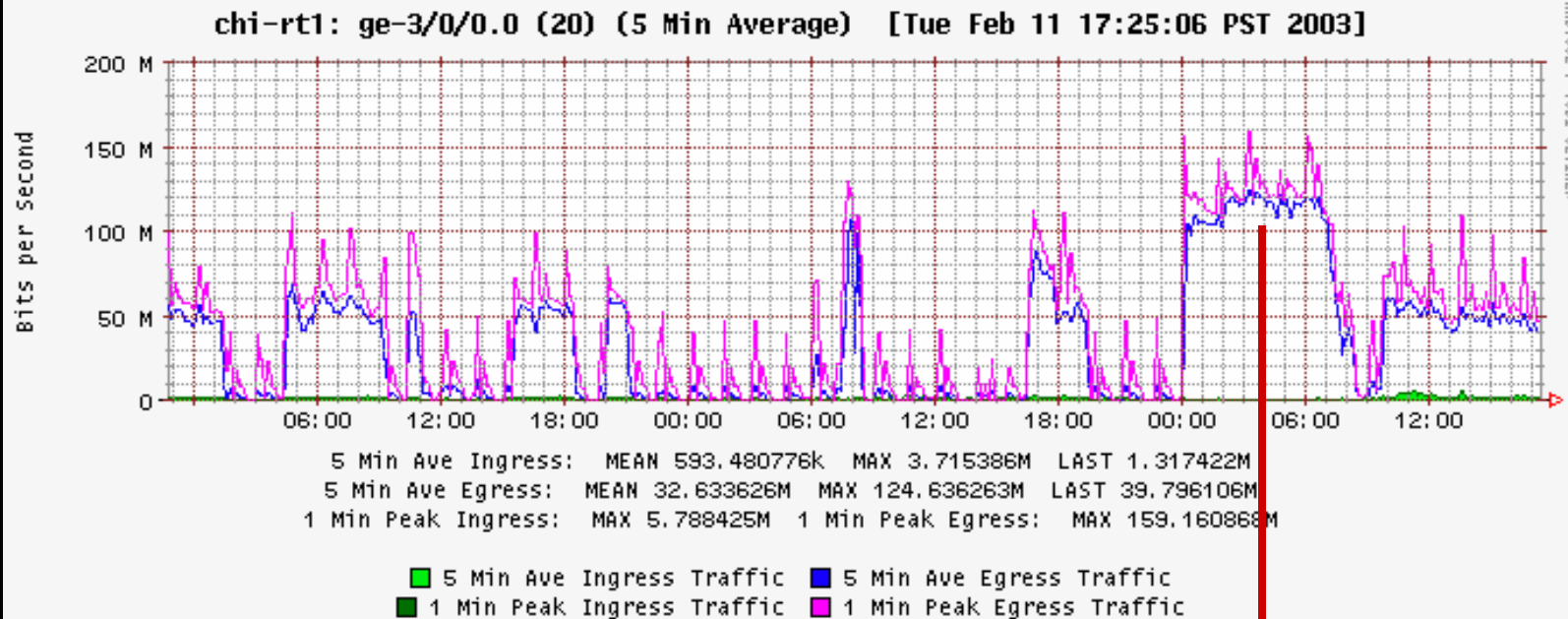
## ESnet to PWAVE via Seattle



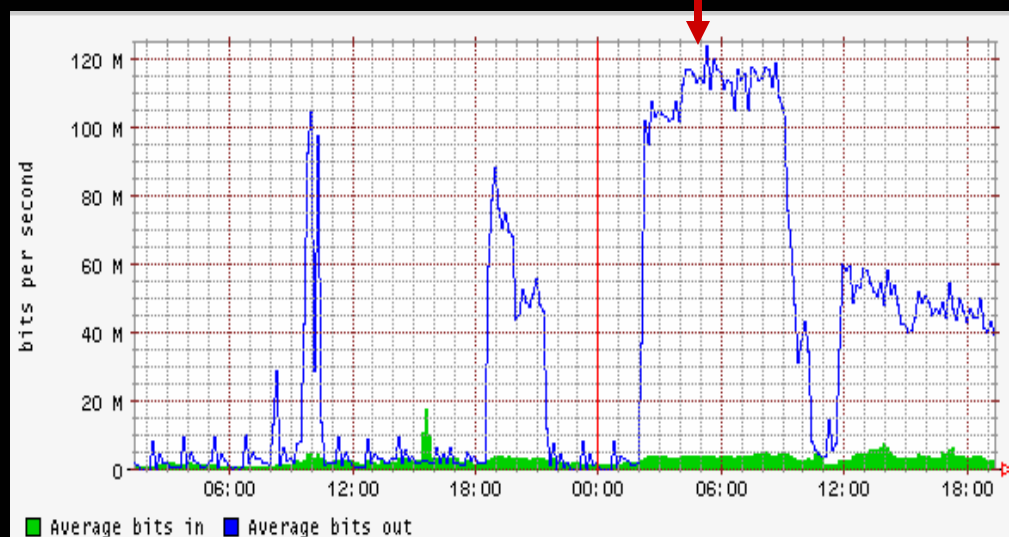


# STARLIGHT (1/2)

ESnet  
To  
CERN  
Via  
Starlight



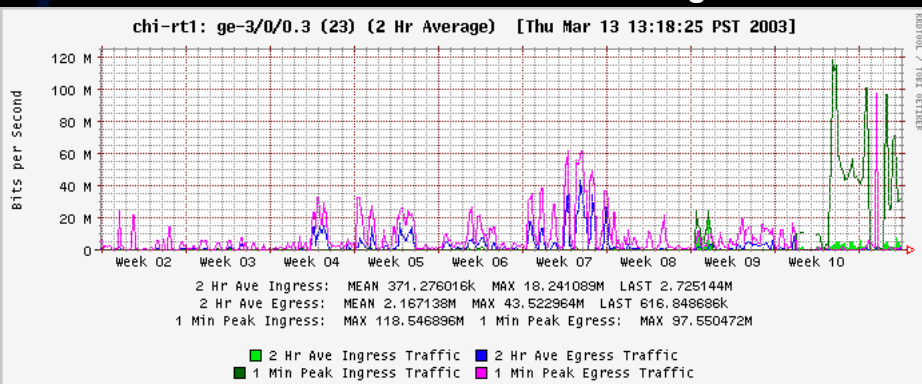
CERN  
at  
Starlight



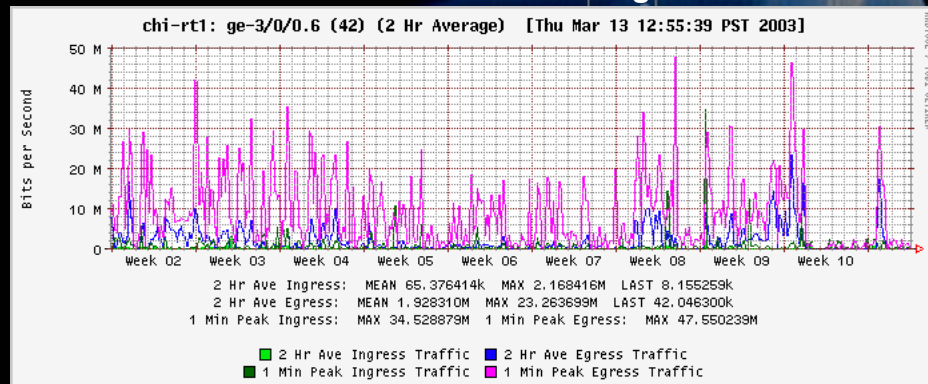


# STARLIGHT (2/2)

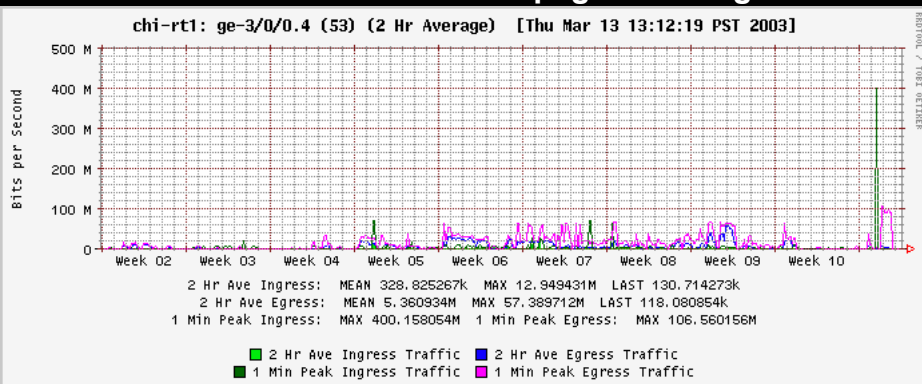
## ESnet to SURFNET via Starlight



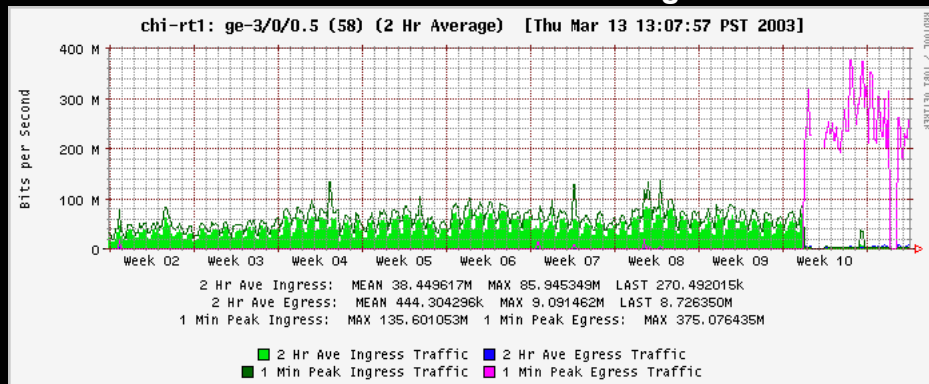
## ESnet to NAUKANET via Starlight



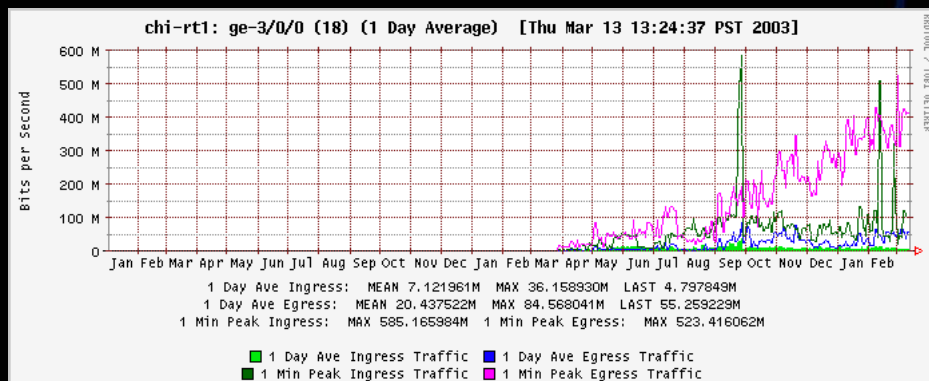
## ESnet to CANET-Winnipeg via Starlight



## ESnet to CANET-Toronto via Starlight



## ESnet GigE to Starlight



# TOPICS

- PART I: Meeting Requirements
- PART II: Status Report
  - Some Statistics
  - Domestic Issues
  - International Issues
  - – Other Services
  - Other Activities
- PART III: Foundation for a Business Case

# Net News Server

- ESnet is rolling out a centralized Net News Server
- Will be purged of (nearly) all non-PC Content
- Oriented toward individual users
  - No username or password is required
  - Security is based by domain and/or CIDR block.
- Now doing “beta” testing with LLNL
- Compatible with many free and commercial newsgroup readers
- Website for Docs, software, FAQ, and other details, coming soon.

ECS (1/3)

# ESnet-Collaboration Services (Early 2003)



## New Home-Grown ECS Web Pages and Registration\*

### Home Grown Scheduling and Registration

H.320  
Videoconferencing

Accord MGC-100

### Latitude Scheduling and Registration\*

Audio  
Conferencing

T.120 Data  
Conferencing

Latitude MeetingPlace

Ad-Hoc  
H.323

RADVISION  
VialP

# ECS (2/3)

## Current Usage

- Latitude Audiobridge
  - Demand is increasing beyond the 7000 plus hours previously reported
  - Expansion is limited by budget constraints
- H.320 Conferencing
  - Continues at about 5000 hours per month
- Ad-Hoc H.323 Conferencing (NEW)
  - Between 200 and 300 hours per month (MCU active)
- T.120 Data Conferencing (NEW)
  - About 180 hours per month and increasing

# ECS (3/3)

An estimate of the annual cost to DOE to replace the current services provided by DCS/ECS with commercial services

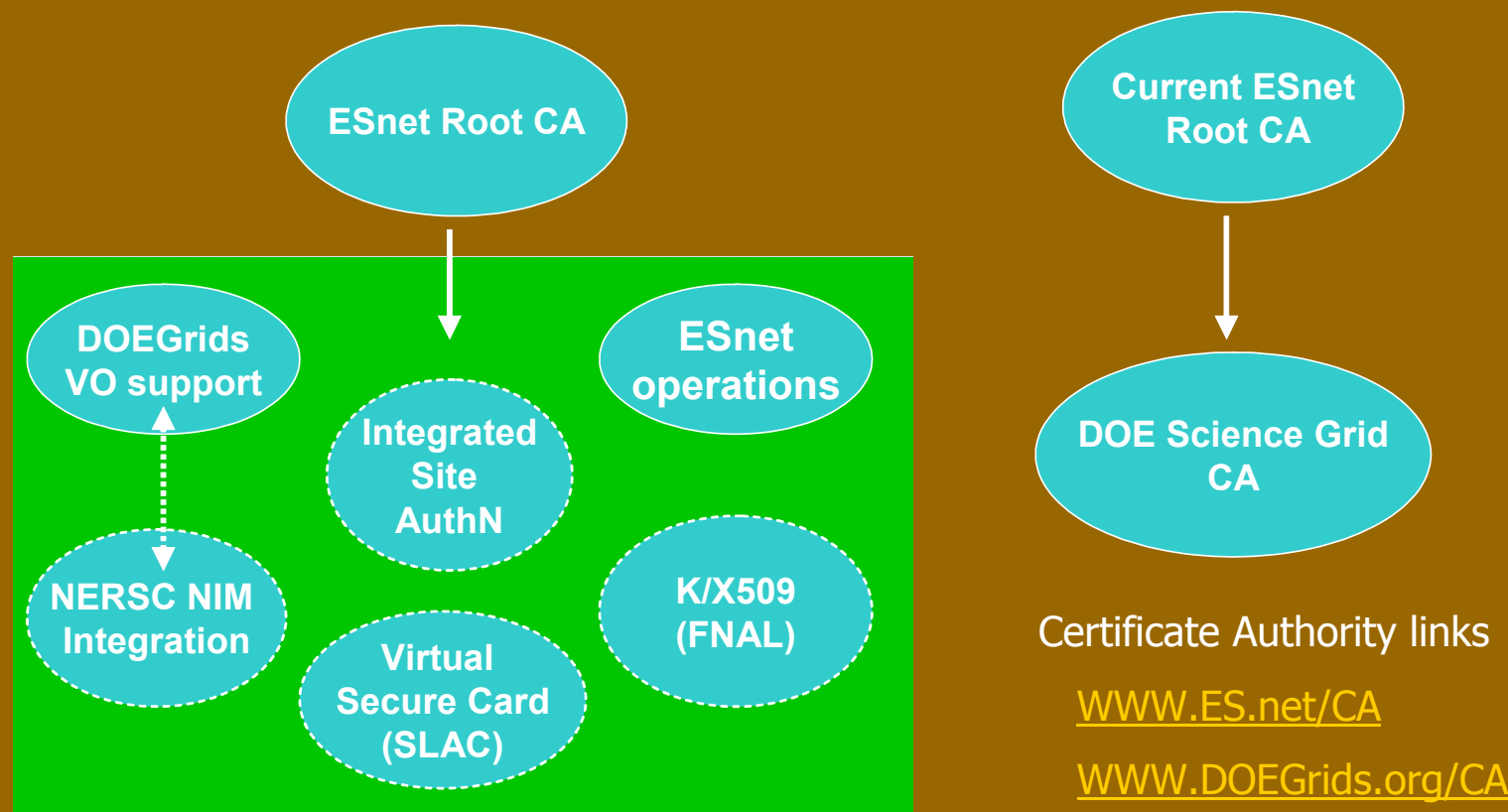
<b>SERVICE</b>	<b>Cost/Hr</b>	<b>Hr/Mo</b>	<b>Annual</b>
H-320 Video-conferencing	\$50	5,000	\$3,000,000
Audio-conferencing	\$10	4,600	\$552,000
Data-conferencing	\$20	180	\$43,200
H323 Video-conferencing	\$50		\$2,000,000
			<hr/> <b>\$5,595,200</b>



## ESnet PKI Service Mission

- Supports DOE Scientists and Engineers working on the new World Wide Scientific Computational Grids.
- Provides Authentication Certificates to individual subscribers and Service certificates for Grid services.
- Support for Dynamic Virtual Organizations.
- Models trust practices in the Scientific community.
- Meet the challenges of diverse business rules.
- Certificates must meet the requirements of the middleware providers.

## ESnet PKI Service Architecture

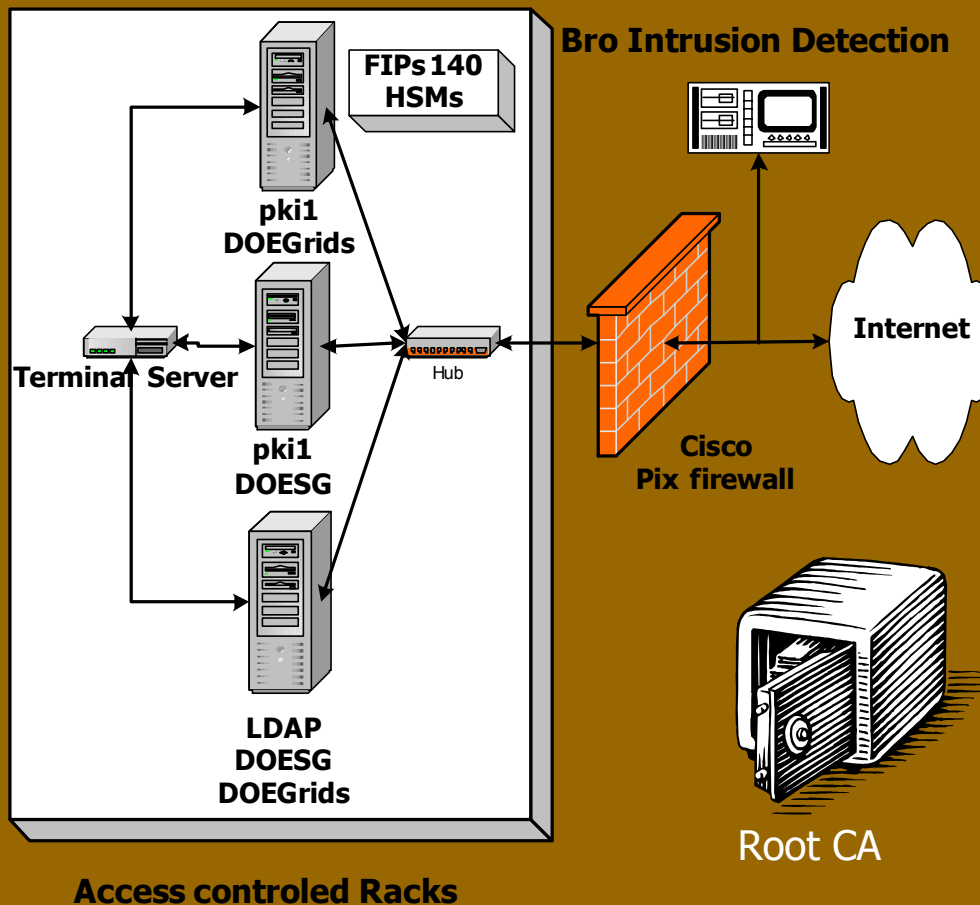


**ESnet subordinate Certificate Authorities and proposed CAs**



# PKI (3/4)

## ESnet Physical Security Architecture



## ESnet PKI Status

- Supports multiple DOE Virtual organizations
- Managed by 16 member PMA
- Facilitates scientific collaboration between US and European High Energy Physics Projects, and within the US Magnetic Fusion community.
- Provides a global, policy based method of identifying and authenticating users.
- Currently used by the SciDAC Particle Physics Data Grid, Earth Systems Grid, and Fusion Grid projects, in addition to the DOE Science Grid

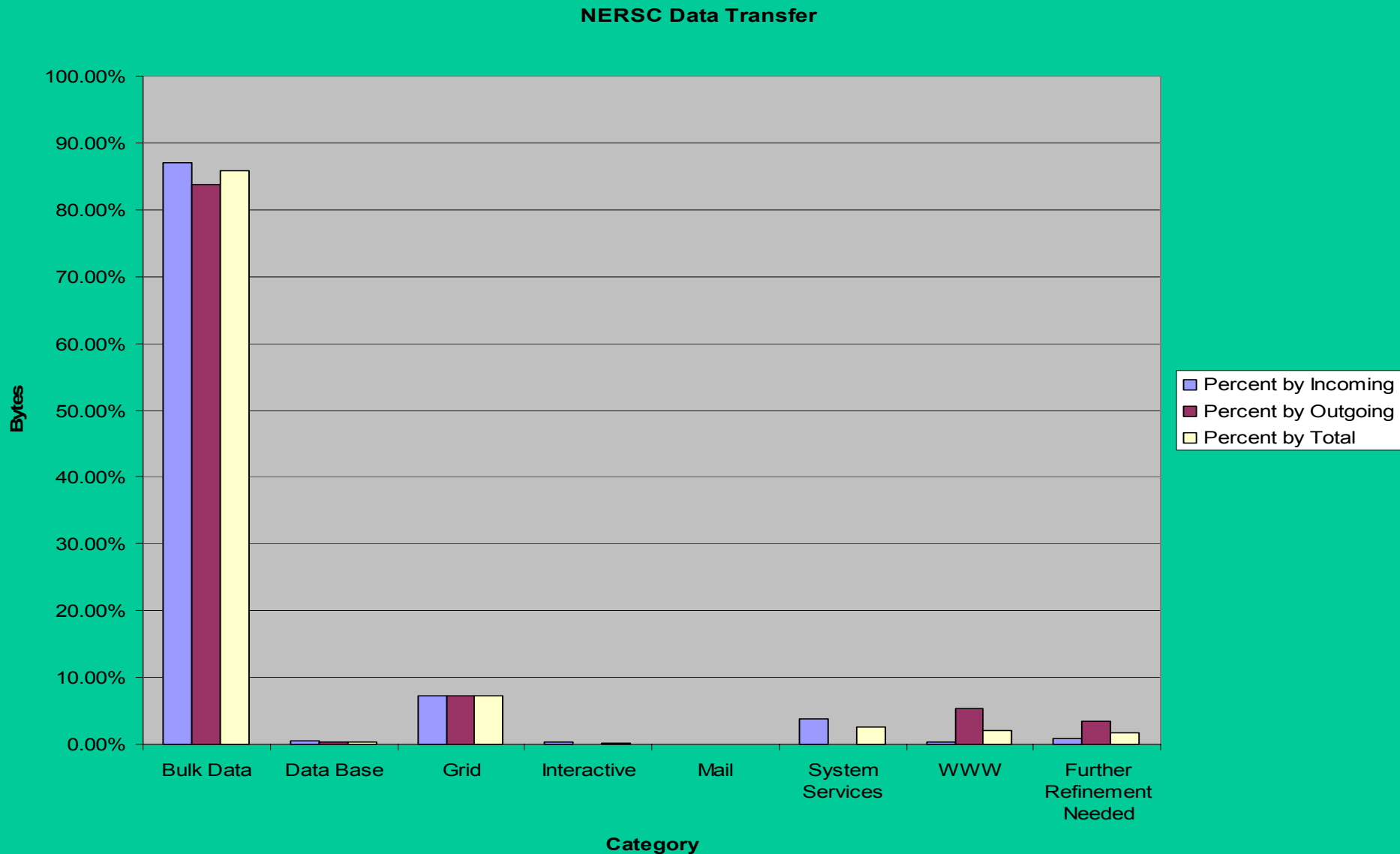
# TOPICS

- PART I: Meeting Requirements
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# Network Measurements (1/5)

- According to Walt P: “Data on utilization/performance of ESnet ... Does not meet MICS-program needs”
- Have established a team to better characterize data as appropriate for MICS
  - ANL (?), FNAL, LBL & NERSC, ORNL, SLAC, ESnet

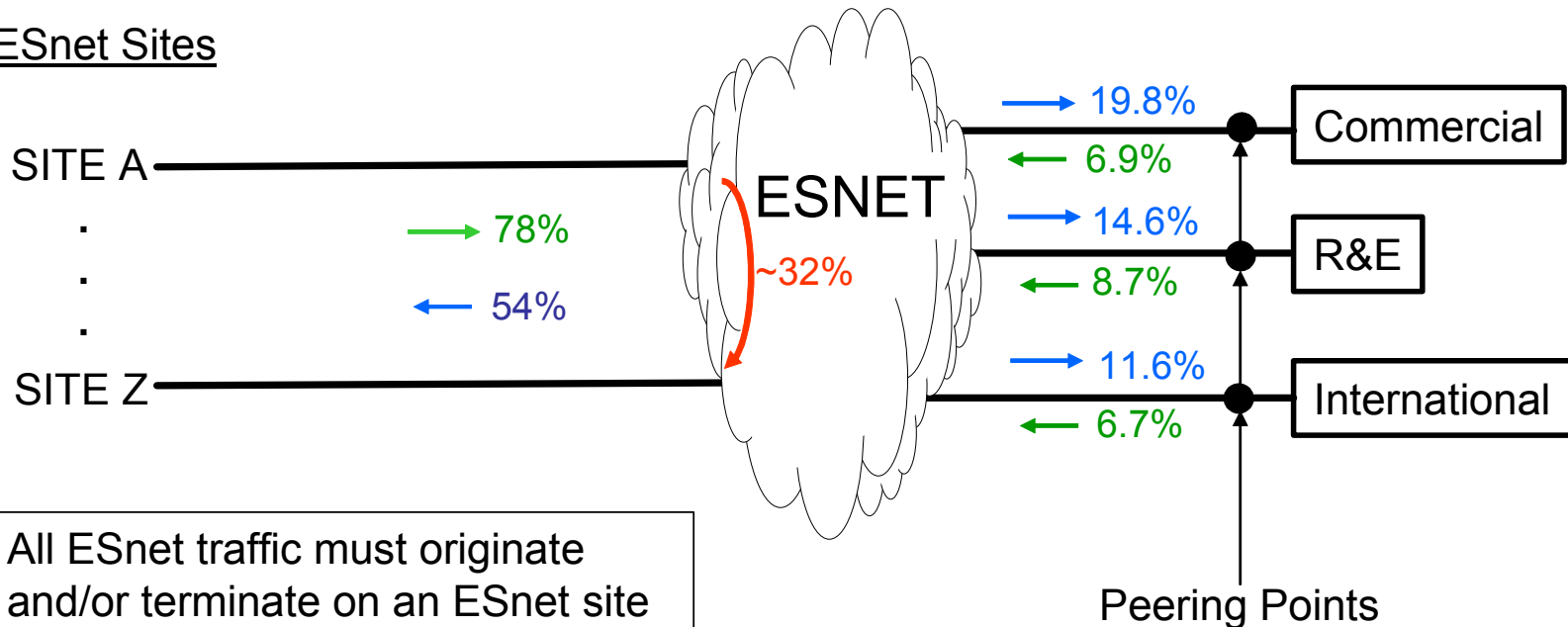
# Network Measurements (2/5)



# Network Measurements (3/5)

## ESnet Inter-Sector Traffic Summary Feb 2003

### ESnet Sites



All ESnet traffic must originate and/or terminate on an ESnet site (no transit traffic is allowed)

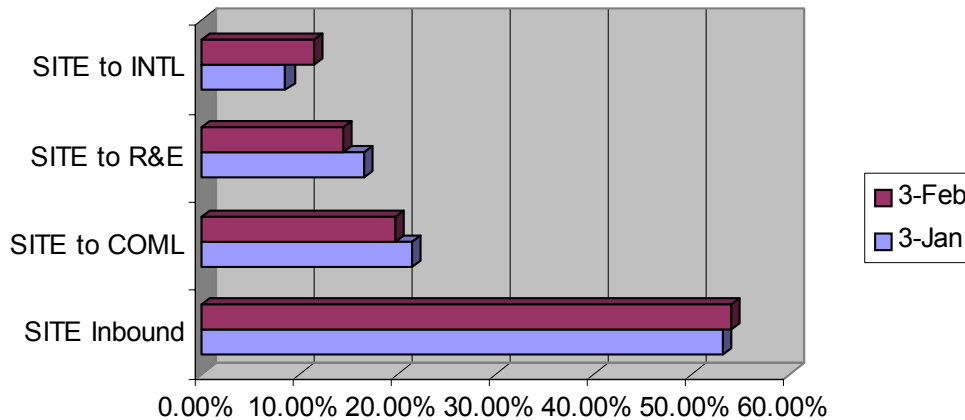
E.G. a commercial site cannot exchange traffic with an international site across ESnet

This is effected via routing restrictions and implementation.

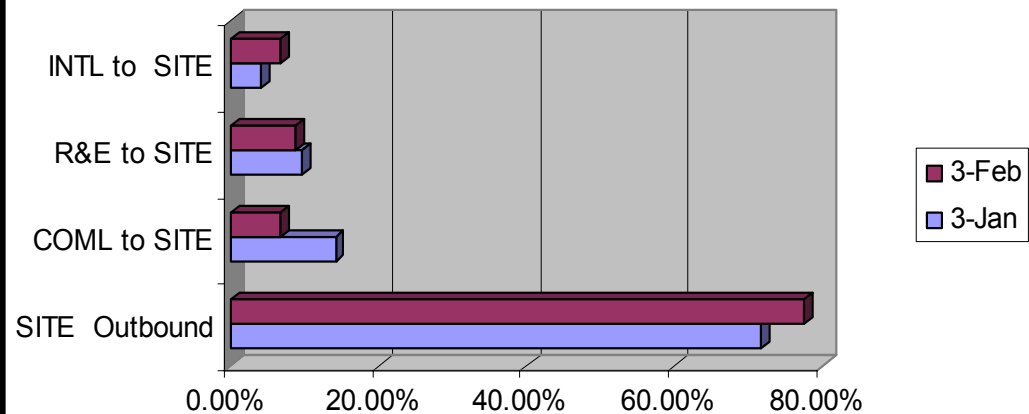
Traffic from a site →  
Traffic to a site ←  
ESnet Ingress Traffic = Green  
ESnet Egress Traffic = Blue  
Traffic between sites ↪  
% = of total ingress or egress traffic

# Network Measurements (4/5)

**ESnet Outbound Intersector Traffic**



**ESnet Inbound InterSector Traffic**





# Network Measurements (5/5)

The background of the slide is dark blue with abstract, glowing lines and patterns. On the right side, there are vertical columns of binary digits (0s and 1s) and some faint, larger numbers like '100' and '10'. The overall aesthetic is technical and digital.

A DEMO: We are also working on plans to give a more “open” look to ESnet:

# Performance Centers (1/3)

## ESnet Performance Center Locations



# Performance Centers (2/3)

## Performance Center Functionality

- Allows Site personnel to run tests
  - Between ESnet Hubs
  - To / From a site host
- Tests currently include
  - ping
  - traceroute
  - **iperf**
- Access via a web interface

# Performance Centers (3/3)

## ESnet Performance Center

[Introduction](#)

[Tests](#)

[Resources](#)

### Iperf testing

This will run an [Iperf](#) test between two ESnet performance centers or between a Performance Center and the host you are running the web browser on.

If you are running tests between two Performance Centers, IPERF tests will be started on each end automatically.

If you are running IPERF to your host, you will need to be running IPERF locally with the correct parameters. The IPERF program can be downloaded from [here](#). Once the test is started from this web page, you will be prompted for the necessary action on your local host.

Please note that the UDP bandwidth values preprogramed on this page were chosen to mimic H.323 video streams from sites.

TCP test

**This test runs a TCP stream between the source and destination.**

Test	<input type="text" value="TCP"/>
TCP Window Size	<input type="text" value="262KB"/>
Time to Run	<input type="text" value="10 Seconds"/>
Port	<input type="text" value="5001"/>
Traffic Source	<input type="text" value="SNV - Performance Center"/>
Traffic Sink	<input type="text" value="DC - Performance Center"/>
<input type="button" value="Run TCP Test"/>	

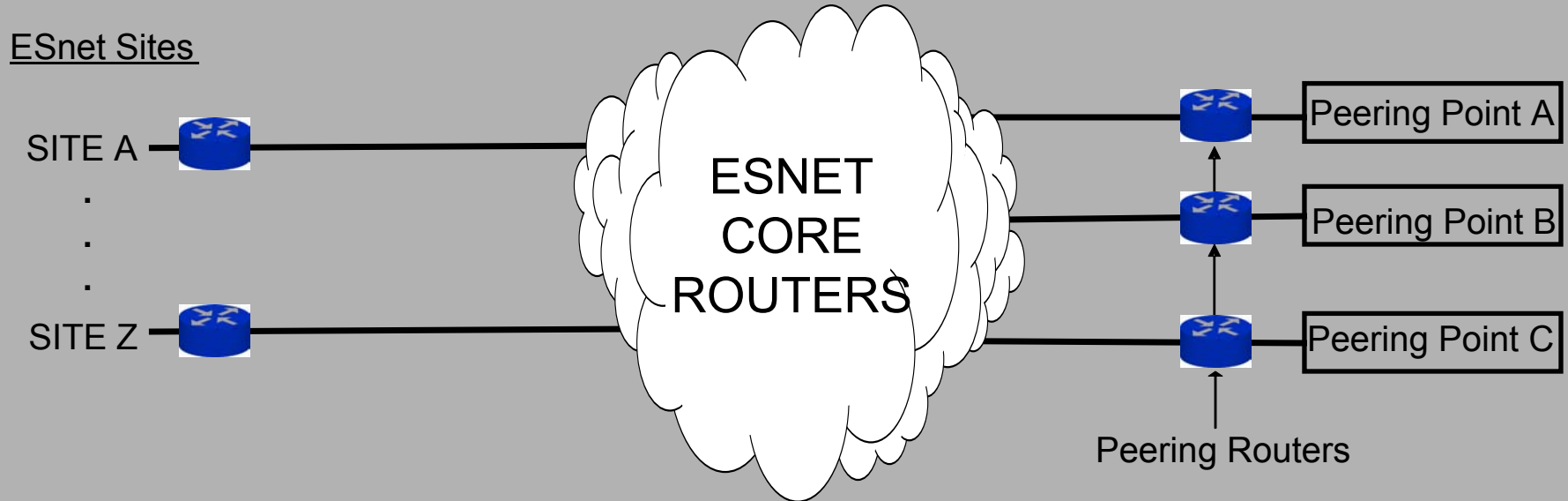
UDP test

**This test runs a UDP stream between the source and destination.**

**Please note: The tests below can seriously impact connectivity to your site. Please use caution when selecting the higher rate UDP tests!**

Test	<input type="text" value="UDP"/>
Bandwidth	<input type="text" value="384kb/S"/>
Time to Run	<input type="text" value="10 Seconds"/>
Port	<input type="text" value="5001"/>
Traffic Source	<input type="text" value="SNV - Performance Center"/>
Traffic Sink	<input type="text" value="DC - Performance Center"/>
<input type="button" value="Run UDP Test"/>	

## ESnet Enhanced Security Architecture Feb2003



- Goal is to have all ESnet external connections come through a dedicated “peering router”
- Allows a separate routing policy to be implemented for external peers
- Allows easy control of external interconnects during a cyber-attack
- Architecture allows possible future “distributed intrusion detection” and/or firewall capability

# Trouble Reports

## Some of My Favorites ....

- We are running simulation Workshop for ALICE experiment at the LHC. That will continue including Sunday, the 17th of November. The proper operation of pdsf is essential to the success of the Workshop. Since a few hours we observed a very significant slow down of the pdsf machines e.g. nodes: 1,2,5,4, 8. I can not run "traceroute" because this software is not installed on my machine .

We would appreciate you if you could take care for the problem.

- I'm having nothing but problems with my emailing and addresses. I compose a letter but when I try to "Insert addresses" nothing happens.

I was told that my email messages from other senders are being returned undeliverable.

Any suggestions?

- I want to report a problem that is none stop in this room The bingo room rm. to much swearing and name calling and the persons ID IS BIRDHOUSE650  
Please do something about him



# Part II

- Conclusions/Observations
  - The roll-out of the new OC48/192 backbone has gone very well.
  - International support seems to be more than adequate to meet near-term demand
  - New services are emerging, doing well, and experiencing rapid growth in demand
  - Network measurements compatible with HQ requirements will be researched, developed, and instrumented
  - An architecture is being developed that may help network security on an ESnet-wide basis

# TOPICS

- PART I: Meeting Requirements
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- • PART III: Foundation for a Business Case
  - Business Model Elements
  - Business Model Rationale
  - Business Model Scenarios
  - Financial considerations

# TOPICS

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# Business Model Elements (1/4)

- Services are centrally funded
  - Funded FY03 by MICS at ~ \$16M+
  - Some cost-sharing augments budget
  - Services include:
    - Network backbone + site access
    - Central Management
      - Procurement, contract, budget, planning, installation coordination
      - Network Operations Center
      - Community outreach (customers, peers, vendors)
    - Collaboration support
      - Conferencing services (video/data/voice)
      - Collaboration services (PKI)

# Business Model Elements (2/4)

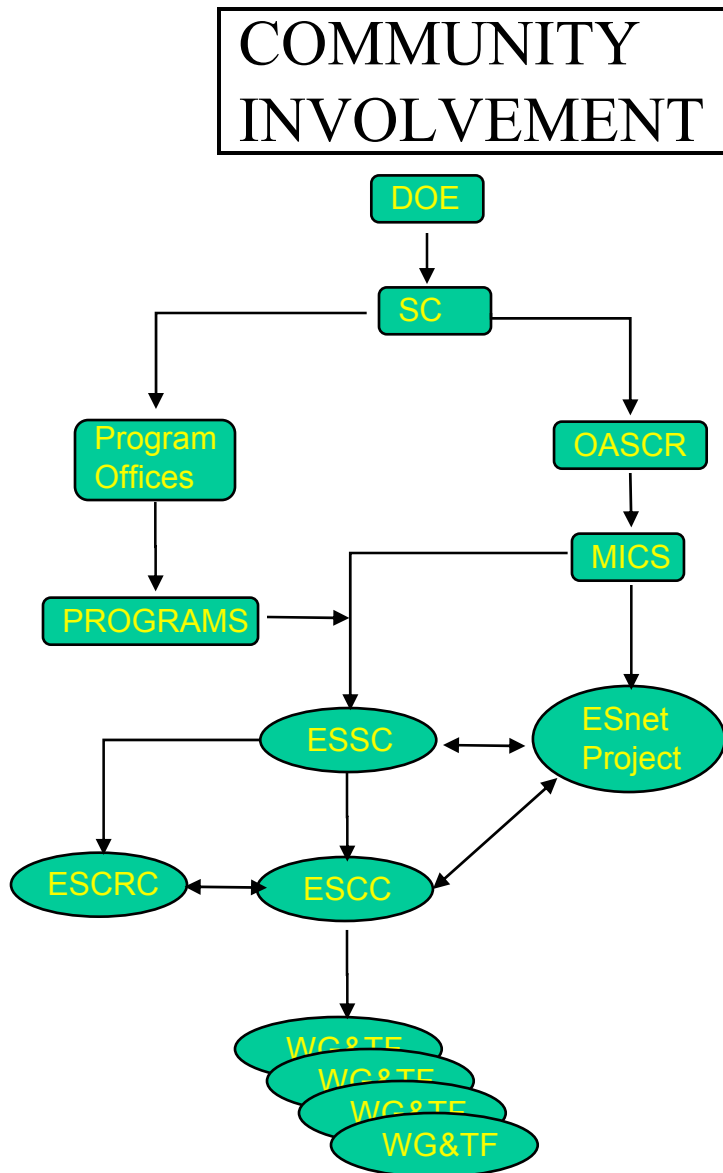
- Services Provisioning
  - ESnet services provided up to site “DMZ”
  - Intra-site networking & security are site’s responsibility
  - Backbone, hubs, and access facilities managed by ESnet in close coordination with vendor(s) and sites
  - Vendor requirements
    - 24x7 basis, ~99.9% uptime
    - Bounded latency (~100msec RTT)

# Business Model Elements (3/4)

- Commercial Services Procurement
  - Master umbrella contract
    - Multi-year (current is 3+2+2 year)
    - Technology “neutral”
    - Includes research and testbed components
    - Framed as collaborative relationship
  - Single vendor, competitively selected
  - Vendor typically provides L1/L2 services
  - Services typically on “MRC” basis under 3-5 year term, but other arrangements used/considered on occasion



# Business Model Elements (4/4)



- The ESnet project enjoys an excellent working relationship with both its technical and program “user” communities
  - The ESnet Steering Committee (ESSC) deals with requirements and priorities as established by DOE representative Program Principal Investigators.
  - The ESnet Coordinating Committee (ESCC) deals with associated site and technical issues.

# TOPICS

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# Business Model Rationale (1/4)

- Central Funding:
  - Significant cost and effort leverage
  - Minimize procurement activity
  - Minimize site tax overhead
  - (Wide-area) network funding is explicit
    - Otherwise would likely come from site overhead funding
  - Easier to (re)allocate resources to meet changing DOE demands and priorities

# Business Model Rationale (2/4)

- Central Project Management:
  - Significant cost/effort leverage
    - Only one 7x24 staffing function required
    - WAN issues addressed on behalf of community
    - Maintains small staff of core competency for technology vital to success of agency science.
  - Allows “default” location for other central 24x7 services (e.g. ECS, PKI, DNS, NetNews, Performance Monitoring, Security, etc)

# Business Model Rationale (3/4)

- Common Networking Infrastructure:
  - Significant effort leverage
    - Common approach allows sharing of experience and expertise within DOE
  - Single identity to external community
    - Leverage in dealing with peering issues with commercial and international collaborators
  - Makes site interconnects a “non-issue”
  - Can do cost sharing with non-OS entities

# Business Model Rationale (4/4)

- Mix of commercial and “in-house” services:
  - Future directions driven by DOE priorities rather than commercial interest
  - Underlying resources dedicated to DOE rather than subject to public demand and pressures
  - Significantly more cost effective than only commercial services
  - Maintains vital core competency



# TOPICS

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# Business Model Scenarios (1/2)

- Eliminate central funding?
  - Each institution responsible for funding its own WAN requirements
  - HE(N)P would consolidate requirements and form HEPnet II
  - Other programs might consider doing something similar
    - Some sites would try to hook-up with Abilene
      - Qwest may intervene
  - Some auditor would recommend:
    - Use DOEnet ... or
    - Use GSA services ... or
    - Consolidate requirements SC-wide

# Business Model Scenarios (2/2)

- Procure “commercial services”
  - But wait ... don't we already?
    - 50%+ of ESnet budget goes to commercial entities
  - We would (presumably) procure ISP services rather than communication services
    - Would be (significantly) more costly
    - Future directions would be driven by vendor's commercial interests rather than agency interests.
    - Little rationale for a network research program
    - Could lose core competency in technology vital to meeting agency science mission
    - Performance subject to public traffic impact
    - Security considerations would be more difficult

# TOPICS

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# Business Case Financials

## Life-Cycle Costs

### Alternatives

1. ESnet
2. Central Funding
3. No Funding

Cost Elements	Alternative 1	Alternative 2	Alternative 3
Planning	\$3.8M	\$3.8M	n/a
Acquisition	\$51.2M	\$75.2M	\$202.4M
Maintenance	\$25.7M	\$36M	\$17.6M
Total FY04-07	\$80.7M	\$115M	\$220M

## ROI Calculations

YEAR =	FY04	FY05	FY06	FY07
Costs	\$19.8M	\$20.05M	\$20.3M	\$20.55M
Net-benefits (Internal)	\$39.6M	\$35.7M	33.4M	\$31.1M
Net-Present Value	\$36.8M	\$30.9M	\$26.8M	\$23.3M
Payback (ROI Internal in weeks)	26	29	31	34

# ESnet Status Report

THE END